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DISCOVERY

A Monthly Popular Journal of Knowledge

Vol. VII. No. 81. SEPTEMBER. 1926 (Annual Subscription 12s.6d. Post Free). PRICE 1s. NET

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DISCOVERY

A Monthly Popular Journal of Knowledge

Vol. VII, No. 81. SEPTEMBER, 1926. PRICE 1s. NET

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Edited by John A. Benn.

Publishers: Benn Brothers, Ltd. All communications respecting editorial matters to be addressed to the Editor: all questions of advertisements and subscriptions to the Manager.

Offices: 154, Fleet Street, London, E.C.4.

Telephone: City 0244 (10 lines).

Telegrams: Benbrolish Fleet.

Annual Subscription, 12*s.* 6*d.* post free anywhere in the world. Single numbers, 1*s.* net; postage 2*d.*

Binding cases for Vol. VI, 1925, can still be obtained. Price 2*s.* 6*d.* net each; postage, 6*d.*

Editorial Notes.

The rapid progress that the county library movement, begun in an experimental form only ten years ago, is making throughout Great Britain and Ireland is indicated by the figures contained in the annual reports for 1925 just issued by the Carnegie United Kingdom Trust. In 1924 the statistics covered 51 county libraries—18 English, 6 Welsh, 20 Scottish and 7 Irish. In 1925 statistics are published from 78 counties—34 English, 7 Welsh, 26 Scottish and 11 Irish. In the whole of Great Britain only seven counties are now outside the movement. The initial and supplementary grants made by the Carnegie Trust amount to £310,000, and it is satisfactory to find that as a result upwards of a hundred library systems exist in areas where ten years ago there were no public library facilities of any kind. It is a fact of interest to all who feel the need of saving our rural life from mental and social as well as economic decay.

* * * * *

The first aim of the movement has been to supply from a county headquarters well-chosen collections of books to villages that could not possibly maintain an adequate independent service. The village centre is, as a rule, the village school, but approved clubs and institutes are also used. In this as in so many other matters, the village schoolmaster is playing an important part. The village librarians are chiefly the village teachers, who have readily given their help without payment, and of whose loyal and helpful co-operation the trustees make generous acknowledgment. The service, though primarily intended for villages, is gradually being extended to larger centres of population, branch libraries of the urban type are being formed in places with populations of 2,000 and upwards, and co-operation is steadily developing with existing municipal libraries and with educational bodies. So far is the movement already able to meet special local needs that special arrangements are being made for a direct postal service to isolated students. The apex of the whole system is the Central Library for Students, which acts as a reserve to all local libraries, supplying on payment of postage any important work that may be in too small demand to justify local purchase. A little imagination will enable anyone to appreciate what all this provision of literature for our village communities means to rural life. For those who desire to know more about the subject, it may be of interest to state that copies of the present report—a thoroughly interesting document—may be obtained without charge from the Carnegie Trust offices at East Port, Dunfermline.

* * * * *

In connexion with this matter, a word may be added on the steady growth of the Association of Special Libraries and Information Bureaux, the object of which is to facilitate the co-ordination and systematic use of all sources of information and reference—to establish, in short, a general clearing house for information of all kinds. The inaugural conference at Hoddesdon in 1924 was followed last year by a much larger meeting at Balliol College, Oxford. The conference for 1926, fixed for 24th-27th September, is again to be at Balliol College. With the assistance of the Carnegie Trust, the association has undertaken, as one of its first activities, the compilation of a directory of sources of specialized information in Great Britain and Ireland. The general editorship of this important work has been entrusted to Mr. G. F. Barwick, late Keeper of Printed Books at the British Museum.

It may safely be said that the proceedings of the British Association meeting held a few weeks ago at Oxford attracted greater public interest than those of any previous gathering in its history. If this publicity was chiefly attributable to the presidency of the Prince of Wales, it was not solely accounted for by that popular curiosity traditionally associated with members of the royal family. This, it is to be assumed, was just as the Prince might have desired, since the subject he chose for his address—an account of which appears on another page—itself merited the most widespread interest; and that the speech was broadcast gave the mass of the people to whom the subject was unfamiliar the opportunity of appreciating its importance.

* * * * *

Among the achievements mentioned by the Prince in his admirable summary of the development of British scientific research, his reference to the first public demonstration of wireless telegraphy by Sir Oliver Lodge evoked considerable applause. That the discovery was revealed at the previous British Association meeting in Oxford, in 1894, together with the presence of Sir Oliver among this year's audience in the Sheldonian Theatre, naturally created great interest. The details of the historic experiment had been made available to members and to the public at large by Sir Oliver's personal reminiscences published in the August number of *Discovery*; and it is a pleasure to feel that we may have been instrumental in ensuring that the importance of the occasion was recognized to the full. As announced last month in these columns, the issue was presented to those attending the Oxford meeting, and any member who may not have received a copy is invited to send us his address.

* * * * *

In the short space of thirty-two years, the discovery of wireless has been developed to an extent that could certainly hardly have been foreseen by those who witnessed Sir Oliver Lodge's early demonstration. Yet it may not be out of place to reflect how many of those who heard the Prince's broadcast speech—whether among the privileged in Oxford or the greater number who listened in their homes—were conscious of the significance of the event. It was our impression that perhaps the majority of those in the Sheldonian Theatre failed even to notice the neat microphones placed on either side of the reading-desk from which the address was delivered.

It is, in fact, seldom that current events are able to be seen in perspective, and this suggests the following observation. In endeavouring to review developments in every branch of knowledge, *Discovery* is conscious that it cannot deal with more than a few subjects in any one issue and comparatively few in the space of a volume. The impossibility of keeping pace with progress is, indeed, a familiar part of the editorial nightmare, which is not unaccompanied sometimes by an element of despair. It is therefore satisfactory, when the annual meeting of the British Association affords the opportunity of taking stock, to find that the latest discoveries reported on this occasion include many that have been described earlier, at the time of their achievement, in the columns of *Discovery*. Although, of course, we take no credit for this—for were it otherwise we should not be fulfilling our purpose—it is evidence that our efforts are not unrewarded and affords assurance to our readers that the journal constitutes a record of the progress of knowledge.

* * * * *

The recent British eclipse expedition to Sumatra was the subject of a lecture to the astronomical section of the Association by Mr. F. J. M. Stratton, who showed among some excellent slides a photograph which first appeared with his article in the June number of *Discovery*. The excavations at Kish, Mesopotamia, undertaken by Professor Langdon in conjunction with the Field Museum, Chicago, and described by him to the anthropological section, were the subject of an article by Mr. Dudley Buxton in April, when the expedition had just concluded the season's work. A paper on the relation of atmospheric conditions to comfort, in the physiology section, discussed the "kata" thermometer, an instrument described by Mr. Angus, technical assistant to the inventor, Professor Leonard Hill, in an article on ventilation in our June issue. The use of sulphur bacteria as indicators of water pollution was outlined by Professor David Ellis in a paper to the engineering section; and the author gives a popular account of this important discovery in an article published in this issue, but which it was arranged he should write for our columns some months ago. Other subjects might be mentioned in the connexion under discussion. With regard to forthcoming features, we are able to announce that Professor Henry Fairfield Osborn, the distinguished foreign member of the Royal Society who delivered a public lecture at Oxford on the discoveries in the Gobi Desert, is writing on this subject for *Discovery*. The article will be illustrated with photographs specially supplied by the American Museum of Natural History, of which Professor Osborn is director.

Water Mites.

By Sir Arthur E. Shipley, G.B.E., F.R.S.

In the twelfth of his articles on animal life seen under the microscope the author deals with water-mites. Accurate details are still wanting in the life-history of this interesting group, which offers scope for investigation.*

"*Natura in minimis maxime miranda.*"—Linnaeus.

MITES belong to the order Acarina of the class Arachnida (spiders, scorpions, etc.) and are, as their name indicates, small; but what they lack in size they make up in numbers. Indeed, mites seem to occur almost everywhere, though they are but seldom observed. Many of them are parasitic. The well-known *Sarcoptes* produces the disease known as the "itch," which was so troublesome amongst the army in the late war. Another mite that infests the human skin is an elongated creature which lives in the ducts of the sweat-gland and produces a minute black spot, generally on the nose or the ear. So widely is this little grub-like creature distributed that enthusiasts declare that it is probably the most widely-known parasite of the human body. Other mites, such as *Phytoptus*, cause those conical galls so common on the leaves of lime-trees, maples, etc. Others, again, live amongst decaying organic matter such as cheese, and the common cheese-mite *Tyroglyphus siro* is perhaps as well known as any other member of the order.

Mites and Museums.

I have myself found mites running about in the air-sacs of a pigeon, and they are a perpetual nuisance to those responsible for our museums, inasmuch as they infest the cases in which the specimens are stored, and devour the linings of the contents. One of the most irritating mites is the well-known "harvest-mite," a little scarlet creature which attacks the human body and causes intense irritation. The "harvest-mite" appears to be the larva of a Trombidium, and probably many species of Trombidium produce this irritating ecto-parasite. A large number of mites are predaceous, feeding on insects and members of their own group. They are most troublesome in the autumn time where these larval forms swarm over the grass ready to attack any warm-blooded animal. Many mites live by sucking animal or vegetable fluid, and for this purpose they have a proboscis which is inserted into the skin of their hosts.

Mites have jointed bodies, and are members of the great group of Arthropoda, which include all the crustacea, the innumerable insects, and the spiders or Arachnida. This last-named group includes the spiders which have a soft, unsegmented abdomen, a number of spinnerets for spinning their webs, and a waist. The Arachnida also include the so-called harvestmen, which have no waist, the scorpions, and the curious marine creature known as the king-crab.

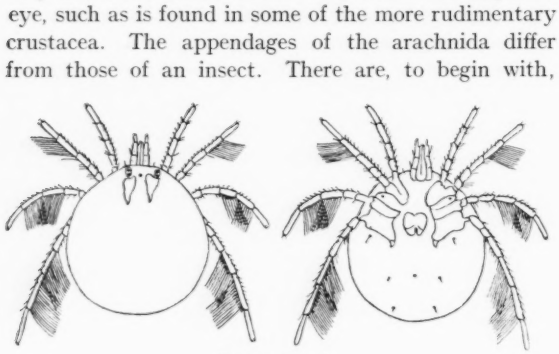
Under the Microscope.

The particular group to which mites belong is characterized by an absence of waist and an unjointed abdomen, and by the presence of typical tracheae such as we find in an insect. The tracheae, however, may be absent, and in that case the little creature breathes through the general surface of its body. There are also numerous free-living mites which enjoy a place in the fresh water and in the sun, and it is these which we must now try to pursue in our chase for animal life under the microscope. The Hydrachnidae are fresh-water mites whose legs are provided with long, closely-packed hairs adapted for swimming. They are predaceous and in their earlier stages, like the red spider, the larva is frequently parasitic, and in that case it lives on the body of fresh-water insects or on fish. These little creatures sometimes spread into brackish water, and one or two become marine. They help to keep down the fauna of the fresh water, feeding on infusoria, mosquitoes and larvae, daphnia, cypris and cyclops. There are somewhere about 400 different species recognized, and we propose to confine our attention to the species Hydrachna. They were first observed by Swammerdam, whose observations and drawings were published by Boerhaave in 1737. He found living on a water scorpion something that looked like an egg (*v.* Fig. 6): this on being opened revealed a mite. The group is not really very well known, for in the majority of cases the description is limited to the adult, and anything like an accurate life-history has yet to be made out in detail. This would afford a favourable subject of study to anyone interested in water animals. The research would not be easy, for it is a wise mite that knows its own father, and to connect the larval form with an adult is not easy.

Water-mites have a more or less flattened body something like a very thick outside slice of an apple. The skin is either soft, or it may be entirely or partly

* Previous articles in the series are listed on page 312.

covered with hard chitin. There are usually four eyes in pairs, and between them lies the so-called unpaired eye, such as is found in some of the more rudimentary crustacea. The appendages of the arachnida differ from those of an insect. There are, to begin with,



FIGS. 1 AND 2.*

1 (*Left*)—WATER-MITE *H. GLOBOSA*, viewed from above, showing the three hinder pairs of legs with swimming hairs, two pairs of lateral eyes, median eye and the proboscis or mouth parts.

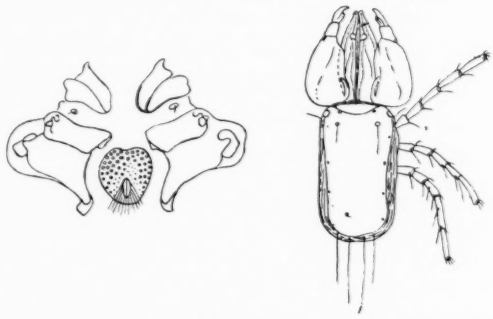
2 (*Right*)—View of the underside showing the plates supporting the legs, the mouth parts in front, and the genital plate in the centre.

no antennae, and there are no true biting appendages or jaws. The first pair of appendages are called the pedipalpae and the second pair the chelicerae. These may be surrounded by an extensive proboscis, and between their bases the mouth opens. The adult form has four pairs of legs, the larva only three. The legs have six joints or segments, and are attached to plates on the ventral or underside of the body (*v.* Fig. 2). The tracheal system for breathing may be present or it may be absent, and the external differentiation of sex may occur or again may be absent.

If we take as an example of these minute fresh-water arthropods *H. globosa*, we shall find that viewed from above the outline varies from a broad oval form to a rather remarkable elliptical one (Fig. 1). Probably the outline varies with the ingestion of food. The length of the body is two or three millimetres, and it has a brilliant red colour, a regular cardinal's red, which deepens in tone as the animal ages. Just behind the head are two thickenings forming two triangles with the pointed end projecting backwards. In connexion with these are two hairs, one at the hinder end, the other at the outer front angle. The eyes are double, two on each side of the median line, and slightly behind and midway between them the fifth or unpaired eye can be seen.

In the Hydrachnidae the pedipalps are usually five-jointed and elongated, the terminal joint being bent backwards to form a grasping organ (*v.* Fig. 4). The chelicerae also usually have a terminal claw. In those members of the group which have breathing organs the tracheae open by a pair of spiracles on the dorsal side of the rostrum, which is slender and usually straight. It hardly extends beyond the joint of the fourth and fifth segments of the pedipalps, which are about 1.2 mm. long, and are slightly laterally compressed. The base of the segment is strongly developed. The thickenings on the dorsal side of the body are shown in Fig. 1, which also includes the double eyes almost fused around the single median eye. Fig. 2 shows the lower or ventral surface with the thickenings which support the median genital plate; these are seen in detail in Fig. 3. All these have value in the systematic classification of the group. Fig. 4 shows the enlarged pedipalp of another species. The first pair of legs vary from 1.2 to 1.8 mm., the second from 1.5 mm. to 2.24 mm., the third 2.1 mm. to 2.4 mm., the fourth and last pair 2.22 to 2.8 mm. in length. The last three pairs have numerous hairs which aid in swimming. Some of these are pectinate. The claws at the end of the legs are sickle-shaped. The anus is about 0.4 mm. behind the genital pore, around which are a number of bristles and certain sucker-like organs known as acetabula.

One common genus of water-mite is found in almost all fresh-water mussels. In fact, it is hardly possible to dissect an Anodonta without finding on the mantle or foot or gills one or more specimens of a small black and white mite known as *Atax bonzi*. This, and another species, *Atax crassepes*, are really not two



FIGS. 3 AND 4.

3 (*Left*)—THE GENITAL PLATES (seen in Fig. 2) MORE HIGHLY MAGNIFIED. The central reproductive plate is supported by thick chitinous plates of irregular shape.

4 (*Right*)—THE LARVAL FORM OF ANOTHER SPECIES OF WATER-MITE, seen from above, showing clawed mouth parts, which in this species are very much enlarged.

parasites, but rather commensals living on the food supply brought into the shell of the fresh-water mussel by the action of its cilia. These two mites pass their entire life in connexion with mussels, leaving one individual only to find another, where they may be seen running about over the ciliated surfaces. The second species, *Atax crassepes*, finds its host after the second larval stage and lives freely when adult. Both species lay their eggs in the gill tissue of the mussel,

* The figures in this article are re-drawn from Soar and Williamson, *Ray Society Publications*.

and here it is that the larval metamorphosis takes place. But in the intervals between casting its skin it may quit the gill chamber and wander about the body.

The eggs of water-mites are laid in or on submerged plants. In *Hydrachna globosa* the egg-laying takes

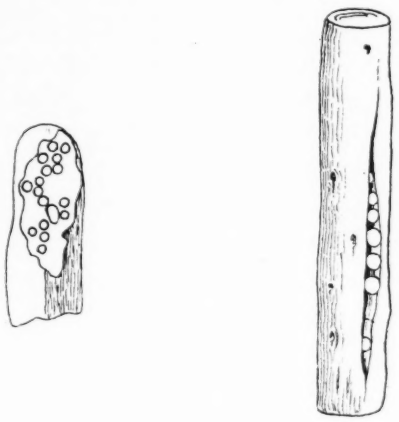
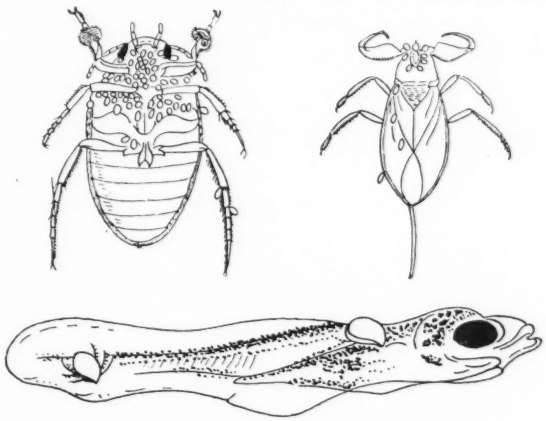


FIG. 5.
EGGS OF WATER-MITES
(*left*) laid on the underside of a leaf; (*right*) in the stem of a reed.

place in May. The female pierces the tissues of a plant with her rostrum; and this species apparently does not surround its eggs by a gelatinous coating. In most species, however, the eggs are laid on the outside of some stalk or leaf (Fig. 5), and each egg is surrounded by a gelatinous layer which is fused into a common mass so that in a way the result is somewhat similar to frog's spawn. In this mass the young mite grows and can be seen developing. In certain insects there is a phenomenon known as hypermetamorphosis, that is to say, the insect is not content with four normal stages—the egg, the larva, the pupa and the imago—but passes through a series of larval forms which differ through a greater or less degree. The same is the case with mites. Young larvae which emerge from the eggs have three pairs of legs, the fourth pair only appearing at a later moult. And until the last stage of all of the adult the genital pair is not complete.

The sexes are always separate and may generally be distinguished one from another, and all species lay eggs. There is no other method of reproduction. Soon after the three-legged larva has hatched, in most cases it attaches itself to some aquatic insect (Fig. 6) to which it hangs on like a minute drop and from which it absorbs its nutriment. They also infest young fish (Fig. 7). During this parasitic stage the larval appendages have dropped off, and the animal comes to resemble a pupa which increases greatly in size as it feeds on its host. From this the pupa-like stage develops an active eight-footed nymph possessing four pairs of legs and palp, which are quite similar to those of the adult. This nymph stage is usually a free-living one, and another moult must occur before it becomes adult. This last moult, however, is not delayed, and may occur whilst the mite is hanging on to water plants.

Water-mites have little economic value beyond the fact that they serve as scavengers, acting like the ostracods in the sea, and they also form the food of other animals. Of course, during the time they are living on their hosts they doubtless injure them to a certain extent, but they do not seem to be fatal. At times they are found in considerable numbers in the stomachs of fish. They are as a rule fairly active, swimming at a fair speed, or walking more slowly over the bottom of a pool or climbing about amongst plants and other objects. At times they rest, and if disturbed seek refuge in flight. They have not been much studied, but seem to be pretty generally distributed over the world, and they show a preference for clear, cool water, rich in plant-life. They are found in all seasons of the year, under the ice in winter, and appear most abundantly in the early spring, becoming adult during the latter part of the summer or autumn. In Great Britain one or two other species



FIGS. 6 AND 7.
6 (*Above*)—PARASITIC LARVAE OF WATER-MITES, seen (in appearance like eggs) attached to two species of aquatic insect.
7 (*Below*)—THREE-LEGGED LARVA INFESTING YOUNG FISH (on the left).

have been found almost wherever they have been sought.

They are not a particularly popular form of animal life, although to the enthusiast they are quite irresistible. Pope in his "Essay on Man" seems to sum up the common feeling about these obscure and imperfectly known arthropods:—

Say what the use, were finer optics giv'n,
T' inspect a mite, not comprehend the heav'n.

The Sudan: Its Exploration and Development.

By Charles W. Domville-Fife.

The opening up of the Sudan is progressing steadily, but its enormous size leaves vast areas still to be explored and developed. The author has just returned from an expedition through this little-known portion of the Empire, which is almost as large as British India.

THERE are few rivers or regions in the world which exercise such fascination over the traveller as the White Nile and the Southern Sudan. This land of contrasts appeals to the explorer because of its wide area of little-known territory and its strange and still savage tribes; to the scientist because of the frequent discovery of some new species of flora, fauna, or relic of the past; to the hunter because of its big game; to the man of affairs because of its scope for development; and to the pleasure-seeking tourist because of its remarkable scenery, varying from the tawny Nubian Desert to the vivid lights and shades in the equatorial jungle of the "Darkest Africa" of to-day.

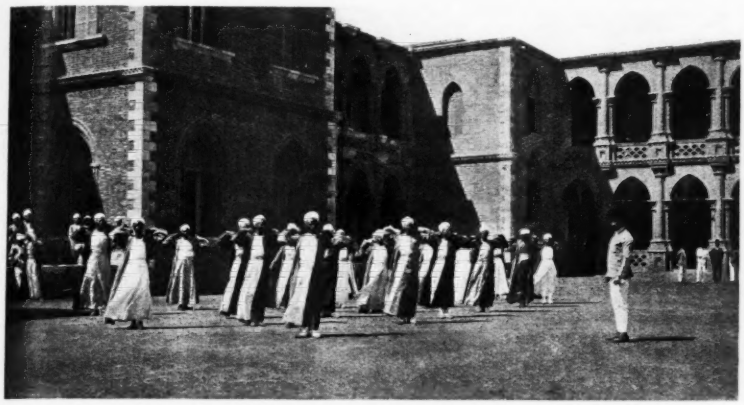
STATUE OF GENERAL GORDON AT KHARTOUM.

The traveller from England has the option of two routes to Khartoum, the chief administrative centre and the starting point of all expeditions into the remote interior. He can journey through Egypt, for a distance of 1,356 miles south of Cairo, to the desert city of Gordon and Kitchener, or he can go by sea to Port Sudan, on the Red Sea littoral, and then travel by railway for about five hundred miles across the hills and deserts of the eastern Sudan to this city of the "Elephant's Trunk," for such is the Arabic meaning of the word *Khartoum*; a name derived from the shape of the peninsula, between the two great branches of the Nile, on which the town is built.

Khartoum is a queer mixture of the ultra-modern and the desert on which it stands. Built in the form of the Union Jack, with the statue of General Gordon in the centre, its buildings are of sandstone, marble and stucco, but its unpaved streets are of the desert sand. It has a steam tramway, at least one good hotel—the Grand, gardens of roses and palms, a newspaper, a club, and several up-to-date scientific institutions, yet it is only three miles distant from barbaric Omdurman, the greatest native city in all Africa.

On the eastern border of Khartoum stands all that remains of Gordon's old palace, upon the foundations and walls of which the new residence of the Governor-General has been erected. A tablet marks the spot on the old stairs where Gordon was killed on 26th January, 1885, and in the gardens behind the imposing Residency the rose tree planted by this great soldier still blooms amid the tropical foliage.

A visit to Khartoum results in many surprises. The first is the comparative coolness of the atmosphere during the winter months, which is due to the elevation of over a thousand feet above sea-level and the prevailing northerly breeze. Then comes the discovery that on the opposite side of the Blue Nile is a modern dockyard, extending for a mile or two along the river bank, where river steamers are built and repaired and all the heavy engineering work required by a new country is carried on almost entirely by highly-skilled native labour. It is a miniature Portsmouth, and is supervised by a distinguished naval officer—now a civil servant of the Sudan. Facing this wonderful series of machine shops and slipways, on the Khartoum side of the Blue Nile, is the Gordon College, in which there are excellent collections of antiquities and physiological and biological specimens. In this building much research work is carried on, and in it are stored all the scientific records concerning this vast country. Outside the Central Railway Station is the Kitchener Memorial School of Medicine, a fine building in which native doctors are being systematically trained.



NATIVE STUDENTS DRILLING AT GORDON COLLEGE.

When the sun dips below the palms, which have overgrown Gordon's old fortifications on the Mogren Point at the meeting of the two Niles, casting gold and pink glows on the waters of the river and tinting also the tropical foliage, distant lights twinkle from across the river and desert. It is the traveller's first glimpse of the great native city of Omdurman, away towards the famous battlefield.

This native metropolis—the largest in the whole continent—is the home of over 100,000 people of all the races of Africa. It has scarcely a single European dwelling among its miles of square, squat native houses and markets, and is an example of a vast city built and walled completely of mud. Standing on the desert and made of desert sand and Nile water it possesses an atmosphere which is both Arabic and barbaric. Many are the queer sights of Omdurman, but above all else there are the marvellous markets or *siks*, wherein ivory, fashioned into all the crude designs of native handicraft, filigree silver, suits of chain armour from Darfur, reputed to be relics of the Crusades, wonderful swords and barbarous spears from the deserts of the north and the equatorial forests of the south, combine with the skins of innumerable wild animals and the black and brown faces of the tribesmen, which even a trained ethnologist would find it hard to classify, to form an almost unique picture of primitive life in the Central Africa of the twentieth century.

The serious traveller will need to spend only a few days in Omdurman before going south to the little-known forests and swamps forming the centre of the continent. The river road into the vast interior is the White Nile, and when once the stern-wheel Government steamer rounds the Mogren Point the last link with civilization is broken. For one, two or three thousand miles ahead lies nothing but a vast, shadowy land, as savage and witch-bound to-day as it was in the time of Stanley, Baker and Emin Pasha.

For the first few hundred miles the surface of the White Nile shines in the sunlight like a lake of gold, ruffled here and there by geese, pelican and thousands of water fowl. The banks are low and flat, with the sandy wastes of Kordofan all around. Here and there a hill of solid stone—sandstone or granite—rises abruptly from the plain, such as that of Jebel Aulia, the site of yet another Nile dam. After passing Kosti and the White Nile bridge (on the line to El Obeid, the capital of Kordofan) there is no sand or riverain cultivation and no semblance of civilization. Dense forests are frequent and patches of tall papyrus fringe the river, now a typically equatorial stream. The mean annual rainfall at Khartoum is only 5.67 inches, but at Kodok, 468 miles farther south, it increases to 28.98 inches and at Mongalla, 1,066 miles,

IN THE MARKET PLACE AT KOSTI, ON THE WHITE NILE.

it becomes nearly 40 inches. From these bare facts the change in scenery from the Nubian flank of the great Sahara to the forests of the Nile-Congo watershed can more easily be visualized.

The muddy waters and aquatic plants of the world's largest equatorial swamp certainly appear to form a most desolate, pestiferous and useless region, but this uncharted morass, in the labyrinths of which

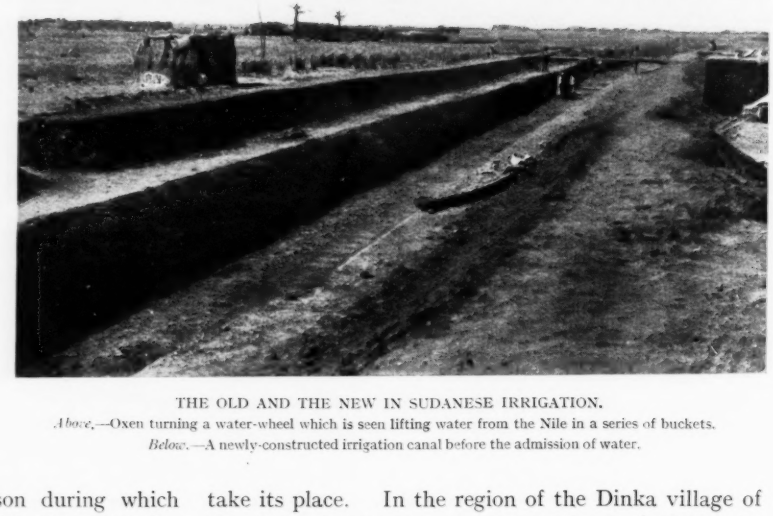
the White Nile loses a large proportion of its precious water through evaporation alone, possesses at least one form of almost inexhaustible but at present latent wealth.

It is said that a world shortage of wood pulp suitable for paper making is within sight, owing to the enormous increase in the use of this commodity and its wastage. It is no exaggeration to say that in the Sudd region of the Southern Sudan there is at least 20,000 square miles covered with papyrus, the finest paper-making material known to science. The difficulty of exploiting this store of raw material is one of transport, combined with the short dry season during which work in an equatorial swamp is practicable. Already, however, plans are being prepared not only partially to drain this vast area, in order to increase the supply of Nile water for the irrigation of Egypt and the Sudan, but also to make available this supply of papyrus and to encircle this lost region by the Cape to Cairo Railway.

One of the lightest woods so far known grows in and around the Upper Nile swamps. This is the ambach (*Herminiera elaphroxylon*), a small leguminous tree from the tapering stems of which the native Shilluks and Dinkas fashion canoe-shaped rafts that are used for hunting expeditions. These craft are capable of supporting one or two adults, two or three children and the household goods of an entire family and yet are so light in weight that they can be carried overland on the head of a single savage. An ambach stem, about 15 inches in circumference and 10 feet long, can easily be supported on three fingers.

Although big game is plentiful in the wild country on both sides of the White Nile south of Kodok, it is not until the Shambé lagoon, about 865 miles south of Khartoum, has been passed that the true elephant country is approached.

The river banks are no longer obscured by papyrus, for tiger grass and um sûf (*P. Pyramidale*) take its place. In the region of the Dinka village of Bor there is known to be a vast herd of elephants, estimated to number nearly a thousand beasts. Here also there are lion, rhinoceros, leopard, cheeta, hyena, wart hog, duiker, gazelle, eland, roan antelope, reed buck, white-eared cob, hartebeeste and such game birds as the bustard and guinea fowl. Of other birds perhaps the most remarkable is the great shoe-bill, or whale-headed stork (*Balaeniceps rex*), although



THE OLD AND THE NEW IN SUDANESE IRRIGATION.

Above.—Oxen turning a water-wheel which is seen lifting water from the Nile in a series of buckets.

Below.—A newly-constructed irrigation canal before the admission of water.

vultures, eagles, hawks, owls, parrots, cuckoos, plaintain-eaters, bee-eaters, fly-catchers, sun-birds, ibises and many other varieties are represented.

Among reptiles the crocodile and the large lizard known as the "warana" are the most plentiful. The largest snake so far known is the python, but much of this vast region still awaits investigation.

Just over one thousand miles from Khartoum Lado is reached. This little place was, in 1874, the headquarters of Emin Pasha. From here onwards the river banks are high and are covered with equatorial forests. Beyond Mongalla and Gondokoro, standing on a tall bank and still showing some trace of human occupation, Sir Samuel Baker's old station can still be seen. Only when Rejaf has been reached, 1,096 miles from Khartoum and 3,013 miles from the mouth of the Nile at Damietta, does navigation for shallow draft stern-wheel steamboats become impossible. From this little post, on the borders of Uganda and the Belgian Congo, trails lead away southwards to the Ripon Falls, over which flow 11,000,000 gallons of water a minute from the Victoria Nyanza to form the River Nile, giving this wonderful stream a total length of 3,526 miles.

A MARABOUT STORK SHOT IN THE SUDAN BIG GAME COUNTRY SOUTH OF KODOK.

In the Western Sudan, around El Obeid, are situated the gum gardens of Kordofan. These so-called gardens are really open forests of acacia trees growing on sandy plains. The trees are tapped in a similar way to those yielding rubber, and the gum is conveyed by camel caravans to the great markets at El Obeid. It is not generally known that a wide belt of gum-yielding acacias stretches across Africa from the Nile to Lake Chad. The great difficulty of exploiting the more distant areas of forest is the absence of transport facilities and of water for the camel trains.

Between the Blue and the White Niles, some 200 miles south of Khartoum, with their centre at the town of Wad Medani, are the Empire's latest cotton fields. The irrigation of what is known as the Gezira—a million acres of black-soiled land between the two rivers—has, at last, been accomplished by the building of the Makwar Dam across the Blue Nile. This stupendous engineering feat and the hundreds of miles of canals depending upon it were completed early in the present year at a cost of 13 millions sterling. The result has been immediately felt not only in the Sudan itself, but also in the cotton manufacturing centres of the British Isles, for 90,000 acres of this valuable commodity were picked and the yield exported between January and April. It is expected that 100,000 acres will be placed under cotton during the coming twelve months. The total area so far irrigated is, however, only 300,000 acres which, allowing for rotation, enables 100,000 acres to be kept continually under cotton, with equal areas under dhurra or other food stuff and lying fallow.

Here again further developments are promised. As already mentioned, the White Nile is to be dammed at Jebel Aulia, which will increase the irrigated area in the Sudan to one million acres, besides making possible an augmentation of the Egyptian water supply.

With the exploration and development of the Sudan new railway lines and harbours have become necessary Lines are projected in several regions and a fine harbour has been hewn out of the living coral at Port Sudan.

Unfortunately, in one place, the submerged coral was found to be exceedingly soft, and quite unable to sustain the weight of a new quay wall, made necessary by the increase of ocean traffic during recent years. This difficulty has been overcome by chipping away the crumbling coral until a firm foundation for the wall was found at a deeper level.

When considering what has already been accomplished in this portion of Africa since the defeat of the Khalifa and the Dervish army at the battle of Omdurman, in 1898, it is well to remember that the Sudan is almost as large as the whole of British India.

The Slug Pest : Its Problems and Extermination.

By T. H. Taylor, M.A.

Lecturer in Agricultural Zoology, University of Leeds.

The peculiar habits of the slug render its extermination a difficult matter. While there is still much to be learnt about this pest, experiments recently undertaken at the University of Leeds have resulted in the discovery of an effective method of dealing with it on an agricultural scale.

SOMEONE has said that all life consists in interpretation, and there is some truth in the saying for, when regarded simply as a fellow-guest in life's feast, even the common slug loses its sordidness, and becomes an object of sympathetic interest. Stripping our minds of prejudice and forgetting old scores, we realize that slugs are not what they seem—an unmitigated nuisance—but bundles of mechanism and skilful adaptations, playing their role as members of a plant-haunting soil-frequenting community. When we reflect how, in spite of their feeble powers of locomotion, their defenceless body and their many powerful enemies, these denizens of the undergrowth keep their place on earth, their much-abused mode of life reveals itself as a strenuous fight against adverse odds ; a tale of enterprise and achievement ; a drama of thrilling, often tragic, events, enacted before a hostile audience, but staged amid open-air and generally romantic surroundings.

The Formation of Slime.

If we consider briefly why slugs are so successful in the struggle for existence, the first characteristic that we notice is their sliminess, a quality which they possess to an unusual degree. Anyone who instead of crushing a slug underfoot attempts to pick it up, will notice how easily it eludes the grasp. Besides rendering the body slippery and difficult to handle, the production of slime (mucus) is apparently necessary for the act of crawling, but its exact function in this respect is difficult to explain. Water snails when they are crawling upside down on the surface of water make a mucus track on which, rather than on the water itself, they creep or swim, and slugs perhaps use their ribbon of slime partly in the same way. Incidentally, the slimy tracks are useful in enabling us to distinguish injuries caused by slugs from those due to other pests. The rapidity with which a slug forms slime when disturbed is remarkable. In a second or two the body becomes coated with a thick white tenacious mantle in which the particles causing the irritation are caught up and left behind as the slug crawls away. A good method of observing the details of the process is to place a slug in water and watch under a lens the shooting out of beads or jets of slime when salt or some other irritant is added to the water. The formation of this " protective " slime, as it may be called, is apparently much more exhausting than that of the ordinary locomotory slime (" trail " slime), and the slug does not appear to be able to repeat the process more than once or twice.

Habits of the Slug.

Slugs are largely nocturnal in their habits. Coming out of their retreats as daylight fails they are active through the night and early morning. When the weather is damp and mild they are sometimes abroad during daytime also. When not on the surface they take shelter under stones, dead leaves, clods and rubbish, or crawl into the soil. It is important to remember their nocturnal habits when measures to control slugs are being discussed.

Slugs have a considerable power of increase. Every slug is both a mating and an egg-laying individual. Thus the number of eggs laid can be judged from the number of slugs that can be counted. Moreover, they can apparently lay eggs all the year round, even in January, provided the weather is not too dry or cold. Indeed, were it not for the occurrence of droughts, which they weather with difficulty, slugs would no doubt be very much more numerous than they are.

There are some other features worth noticing. The surface of the body is channelled by numerous grooves which mark out a mosaic pattern of low rounded elevations. On the " shield " these furrows are absent, but when the animal is active there arises a series of ripple-like foldings which move in endless succession from behind forwards to the margin. Why the animal, besides spending its energy in forming a copious exudation of slime, should maintain in its skin this constant shivering or seething movement is at present unexplained.

The locomotion of a slug is a curious process, as anyone who places a slug on a piece of glass and holds it upside down can witness. The " foot " is pressed close to the glass, and the body as it moves exhibits a series of dark bands which pass in an orderly succession like shadows from tail to head.

Another interesting process is that of feeding. The tongue of the slug is covered with row upon row (120 according to Sorauer) of fine teeth and serves like a flexible file to rasp off pieces of leaf or stem and convey them into the mouth. This process can be well studied in a water snail when it is crawling upon the green-coated side of an aquarium. First the lips are drawn aside and then the tooth-covered tongue is protruded, and by a kind of licking movement rubs off the green substance and carries it back into the mouth. A horny plate, crescentic in shape, lies in the roof of the mouth and serves no doubt to dislodge the fragments of food and thereby clean the tongue and prepare it for the next bite.

The aperture lying on the right side of the body leads into a cavity which has blood-vessels in its walls, and is consequently regarded as a breathing organ or lung. The lung lies under the hump of the body (" shield "), and it is here that there is situated in the skin a small shelly plate which is all that remains of what was probably once a large shell enclosing the body, or most of it, as does the shell of a snail. The shield projects freely over the front part of the body and conceals the head when the slug is retracted.

Life-History Problems.

Common as is the grey field slug its life-history is by no means completely known. The best information at our disposal is given by J. W. Taylor in his " Monograph on the Land and Fresh-water Mollusca of the British Isles." As already mentioned, the eggs are laid at all times in the year, and are as often seen in winter as in summer. They are deposited in the soil under stones, clods, dead leaves, or in rubbish heaps, generally in clusters up to a dozen or more in number. The separate eggs are spherical in shape and of glassy transparency, resembling grains of sago. They hatch in three or four weeks into baby slugs which are like their parent in appearance and are able to feed on plant tissue from the outset of their career. They grow quickly, and probably attain their full size and egg-laying powers in a few months, but detailed information is lacking on this matter and also as to the length of time they live.

These remarks refer to the grey field slug, which is the commonest kind of slug and is the most destructive. It is pinkish-grey but varies a good deal in colour, being often flecked and mottled with orange and brown markings. There is a second species of slug which is also numerous and destructive. This is much darker in its general colouration and exhibits blackish lines running along the two sides of the body and a blackish lyre-shaped band on the shield. This kind may be called the black field slug. One distinctive character is the colour of the foot and of the slime, both of which are yellowish, or even orange-yellow. The eggs, also, are somewhat yellowish in colour.

From the above account it will be seen that there is still much to be learnt about the life of our commonest slugs. Unfortunately, they are dirty animals to keep in confinement, and daily attention to the cage is required to maintain them in health and activity. But if they are looked after, and some pains are taken to record observations, it is within the reach of anyone to add to our knowledge of their habits.

When endeavouring to find a means of checking the mischief caused by an animal pest, the grower should bear in mind that each pest has to be dealt with on its own footing as though it were the only one in existence. No doubt the experience gained in controlling any one mischief-maker is of help, but it does not do away with the need of studying the next, its life-history, habits, and likes and dislikes, especially in regard to food. Another point to remember is that pests are often, perhaps generally, kept in check by natural agencies which sometimes reduce their numbers almost to zero, and that such an occasion should be regarded as an opportunity for increasing our efforts to annihilate the enemy. Although it is true that prevention is better than cure, and often the only measure possible, fortunately when fighting slugs we can by taking advantage of their weak points often effect a rapid cure. Thus, for example, their habit of sheltering under stones, etc., renders them easy to trap. Wooden boards, tiles, or slates placed on the ground form good traps, especially, it is said, if the underside be first smeared with fat. Cabbage leaves are also often used for this purpose. The traps should be kept in constant use and inspected regularly at short intervals. Trapping is no doubt useful in gardens and other limited areas, but for field work some more rapid and energetic method is required.

Copper Sulphate.

In North Wales, where sheep are much troubled with liver-rot, experiments carried out by Dr. Walton, of Bangor University College, have shown the efficacy of copper sulphate in controlling this disease. The " Liver Fluke " which causes liver-rot in sheep and other grazing animals, spends the first part of its life in a small water snail, and consequently it is of first importance to destroy these snails. It was found that when sprayed on their breeding grounds, copper sulphate destroys snails wholesale. Compared with a slug, a water snail is small and fragile and, moreover, being largely aquatic it is more accessible to copper

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sulphate in solution ; but these experiments suggested to Mr. A. W. Anderson, then of Leeds University, the idea of trying copper sulphate for killing slugs. At first a 3 per cent solution of copper sulphate was used, being distributed by means of a horse-drawn spraying machine. The spraying was done after dark, and next morning when the field was examined dead slugs were found where the machine had passed. There is no difficulty, it may be added, in finding slugs that have been killed by copper sulphate ; as soon as a slug is struck by the spray it exudes its white "protective" slime, which remains adhering to the ground and marks the place where the slug was struck. It is thus only necessary to locate a white slime patch and then to follow the locomotory trail in order to discover the dead slug, which is generally only a foot or two away. Apparently when copper sulphate falls on a slug's body a paralyzing effect is produced which does not stop the production of slime but does prevent the animal from crawling more than a short distance. The slug, therefore, generally comes to a standstill on the surface of the ground, and soon begins to dry up.

Practical Application.

There is apt to be some difficulty in carrying out this method, since a supply of water is not always at hand. Moreover, even if a spraying machine is available, the spraying has to be done in bad light when the operator may not be able to keep the nozzles and other parts of the machine in good working order. For these reasons, Mr. Anderson made trials of copper sulphate in its original form of a dry powder, using it both alone and mixed with common field dressings, such as kainit, lime, and salt. Of these the mixture with kainit gave the most satisfactory results. By itself kainit is not deadly enough, but when mixed with copper sulphate, in the proportion of 5 lb. of the sulphate to 1 cwt. of kainit, it was found to form an excellent compound, being both a sure slug killer and also a useful plant fertilizer.

It is interesting to notice in passing that among the other purposes to which copper sulphate has been put in agriculture, it is used as a cure for stomach worm (parasitic gastritis) in lambs ; for spraying charlock in corn ; and it forms an important ingredient in various fungicides, notably the Bordeaux and Burgundy mixtures, and is used as an astringent in veterinary practice.

In spraying for slug, there is one all-important rule to observe. As will have been gathered from the account of the slug's habits, spraying is effective only when the slugs have left their shelter and are present on the surface. To take effect the material must fall on their body. It follows that the best time to spray is between dusk and early morning, the operation being all the easier if it is done in moonlight. It is apparently owing to neglect of this rule that so little has been done to check the ravages of slugs. The usual plan has been to spray the lime, salt, or soot during daytime in the hope that when the slugs begin to come on the surface they will be destroyed. Although they do not readily crawl over a distasteful area, they take no harm when they do so, and the late Miss Ormerod mentions having seen them "resting as comfortably on slaked lime as they would under a stone."

Another precaution which has generally been disregarded is that when lime, salt, soot, or kainit is used the spraying must be done twice or three times. After one application of these substances the slug, having fended off the irritant, crawls away apparently none the worse. This repetition, of course, means double labour, and it is perhaps not surprising that few are willing to spray for slug. Now, however, that copper sulphate has proved itself to kill at one application, as the result of Mr. Anderson's trials,* the labour is halved and is not too severe for general use.

* These are described in Bulletin No. 143, issued by the University of Leeds and the Yorkshire Council for Agricultural Education. A copy can be had on application to the Professor of Agriculture, the University, Leeds.

British Metallurgical Achievement.

An exhibit demonstrating a notable achievement of British metallurgical chemistry was on view at Bouverie House, Fleet Street (the offices of *Discovery*) at a recent reception given by our contemporary, *The Chemical Age*, to a large company of scientists associated with the chemical and gas industries. This was a small sample of electrolytic beryllium of a remarkable standard of purity (99.8% Be), produced by the National Physical Laboratory, Teddington. A white metal, with a brilliant surface when ground, beryllium, though surprisingly light, is nearly as hard as iron. Its successful laboratory production in this country is believed to be in advance of German and American research, and when it is possible to produce it on the large works scale it will probably have an important bearing on light alloy manufacture and engineering construction, on account of its combined lightness and strength. Beryllium is prepared from natural beryl, a mineral which is found in Canada and other parts of the Empire, and two small blocks of which, quarried in Kenya Colony and British Somaliland, were also on view.

The Development of British Scientific Research.

Address by H.R.H. the Prince of Wales.

Following the forecast of the British Association programme published in our August issue, we give below a descriptive summary of the presidential address by the Prince of Wales. Other impressions of the Oxford meeting will be found in this month's editorial notes.

THE ground covered by the papers presented to the annual meeting of the British Association for the Advancement of Science is so extensive that even the specialist finds himself fully occupied in following the proceedings of a particular section. Perhaps, however, the general impression afforded the visitor, as being an insight into current research which it is certainly not easy to obtain elsewhere in the short space of a week, is the most valuable feature of the occasion; and this is particularly true when the annual meeting takes place in a city having the associations and facilities of Oxford. This year, however, another circumstance combined to make this impression complete, in that for his presidential address the Prince of Wales happily chose to review the development of the relations between science, the state, and the community. This not only provided an admirable prologue to the week's proceedings but, since the royal speech was broadcast, gave the public at large an opportunity of taking full interest in this important subject.

Increased Public Interest.

Every meeting of the Association since its inception nearly a century ago has seen some announcement or other of outstanding importance, although the more general concern that its proceedings now provoke has not, of course, been characteristic for the same space of time. Even to-day the attitude of mind which—to quote the presidential address—"personifies science somewhat as the ancients personified the powers of darkness," is only beginning to be dispelled on any widespread scale. While this year's record attendance was largely attributable to the special circumstances of the meeting, it was none the less significant of the increasing popular interest in scientific achievement.

How different was the state of affairs when the Association first met in Oxford was recalled by the Prince of Wales early in the presidential address. The university was not, in 1832, without distinguished cultivators of science, the invitation to meet there coming from Charles Daubeny, who combined the professorships of chemistry, botany, and rural economy.

But a strong body of opinion resented the recognition of science by the university when carried to the extent of conferring honorary degrees upon four of the distinguished visitors. The famous Keble, moved for once to anger, referred to those who were thus honoured as a "hodge-podge of philosophers" Their names were David Brewster, Robert Brown, John Dalton, and Michael Faraday. Each of these men has left in the history of his own special branches of science an outstanding memorial. . . . Faraday's labours provide one of the most wonderful examples of scientific research leading to enormous industrial development. Upon his discovery of benzene and its structure the great chemical industries of to-day are largely based, including, in particular, the dyeing industries. Still wider applications have followed upon his discovery of the laws of electrolysis and of the mechanical generation of electricity. It has been said, and with reason, that the two million workers in this country alone who are dependent upon electrical industries are living on the brain of Faraday; but to his discoveries in the first instance many millions more owe the uses of electricity in lighting, traction, communication, and industrial power.

The State and Research.

In the main theme of the presidential address the Prince took full advantage of his wide experience as an onlooker of the many practical applications of science to the needs of present-day civilization. In the relation of the state and research a notable change of attitude was also to be observed, though in advocating the advantages of state investigation, His Royal Highness as the concluding note of his speech laid marked emphasis on the primary importance of individual initiative.

In an article contributed by Brewster to the *Quarterly Review* in 1830 (it was recalled) he asserted frankly that "the sciences of England" were "in a wretched state of depression, and their decline is mainly owing to the ignorance and supineness of the Government" as well as to various other causes which he detailed. The same theme—if less forcibly stated—recurs in some of the earlier addresses from the chair of the Association: the Prince Consort, for example, as President in 1859, thus indicates his view of the situation at that time—"We may be justified in hoping," he said, "that by the gradual diffusion of science, and its increasing recognition as a principal part of our national education, the public in general, no less than the legislature and the state, will more and more recognize the claims of science to their attention; so that it may no longer require the begging-box, but speak to the state, like a favoured child to its parent, sure of his parental solicitude for its welfare; that the state will recognise in science one of its elements of strength and prosperity, to foster which the clearest dictates of self-interest demand."

The President continued that it might fairly be said the position foreshadowed in those words was now, in a large measure, attained, the beginning of a

new era having been marked by the establishment of the National Physical Laboratory. It is interesting to recall the early connexion between this now well-established institution and the British Association, for it was first set up in Kew Observatory, a building which, as a laboratory for magnetic and meteorological observations and for the standardizing of instruments, owed its maintenance to the Association for some thirty years. In 1900 larger premises at Teddington were placed at the disposal of the Laboratory by the crown.

History of Development.

The events which have strengthened interaction between science and the state were then dealt with in historical sequence, mention first being made of the establishment of the Development Commission in 1908. Since that date the Rothamsted station, previously the only agency for agricultural research in Great Britain and a private benefaction, has been expanded to cover the whole field of plant-life, while several institutes have been founded to deal with other aspects of agriculture. The constitution of the Medical Research Committee in 1913, under the Insurance Act of 1911, was next recalled, the Prince paying tribute to its labours; in 1919 this body was transferred to a committee of the Privy Council under the name of the Medical Research Council, with funds directly voted by Parliament instead of being drawn from the contributions of insured persons. Finally, the creation of the Government Department of Scientific and Industrial Research was discussed. Although an event which falls, historically, within the period of the war, as an outstanding incident in the scientific advancement of national affairs, it certainly was not to be regarded as merely a war measure.

The Great War (said the Prince) caused a broadening, so to speak, of the scientific horizon for men of science themselves in some measure, but for the layman in a measure far greater. We all were brought to recognize the applications of science as adding, it may be, in certain respects to the distresses of warfare; but also as immensely alleviating the sufferings caused by it, and as indicating many methods of strengthening the arts of defence—some of which methods are no less valuable in strengthening the arts of peace.

Some mention of the activities of the department, controlling as it now does eleven boards which co-ordinate and govern research in such widely divergent fields as fabrics, radio, and fuel, concluded the historical survey, in the course of which the President gave an account of many of the recent discoveries and achievements of British research.

In dealing first with problems of agriculture and fisheries, the question of river pollution was mentioned; and in this connexion, as in another matter of general practical concern, the Prince included one of several delightful humorous touches that characterized his speech. "Though fishing," he said, "has been described as 'a fool at one end of a string and a worm at the other,' the subject is not without its personal interest, I believe, to many learned men." The application of scientific methods in the laundry industry was described as "perhaps the most homely example of all" among directions of research that touch upon commonplaces of our daily life, which would "be good news to those of us who may have suffered, or may even be suffering to-night, from the torture of a collar which comes back from the wash with an edge like a surgical saw."

The state is actively concerned, of course, with the promotion and co-ordination of medical research towards the conquest of disease.

Insulin (it was stated), a gift to science and to humanity from young enterprise and enthusiasm in the Dominion of Canada, is not only saving lives that were threatened, and restoring almost to normal health and enjoyment many that were crippled by weakness and restriction but, as a tool of investigation, is shaping new knowledge that will influence all our ideas of the functions of the body, in health or disease. The discovery of the vitamins, those still mysterious and minute constituents of a natural diet, has brought understanding of various defects of health and of development, created for us largely by the blindness of civilization to dangers accompanying its progress, dangers which science can avert. Closely linked with the discovery has been the more recent development of knowledge concerning the need of sunlight for health, in man and his fellow animals as in plants. We know now that crippling deformity appears in the growing child unless he receives his proper share of the vitalizing rays of the sun, either directly or through the presence in natural foods of vitamins which these rays have produced. Sunlight, or its artificial equivalents, have some importance already in the treatment of disease; but a realization of its significance for health has a much greater importance in preventive hygiene. There can surely be no plainer duty, for a state charged with the health of an industrial civilization, than to promote with all its resources the search for such knowledge as this, as well as to provide for its application when obtained.

The Problem of Cancer.

Among diseases which painfully affect the popular imagination cancer has an evil pre-eminence, largely on account of its mysterious and therefore seemingly inevitable nature. For many years past a volume of investigation, supported by private benefactions and organized charity, has patiently accumulated knowledge of the beginnings of cancer and the conditions of its growth. Now, at length, there are signs of more rapid progress towards a penetration of its secret. Patience and caution are as necessary as ever; a new and exacting technique is still in development; but there is a new spirit of hope and enthusiasm. And it is reassuring to know that in this, as in other directions, the state is giving its direct support to investigation, and co-operating with the foundations due to private generosity.

The Prince concluded his presidential address in saying that one more duty remained to him—a duty to hosts and to guests. The University and City of Oxford had received the Association with a high hospitality worthy of that town, to which all who had known it in the past always returned with delight, and which never failed to throw its spell on those who saw it for the first time. Their friendly reception had made it possible for those who had worked so hard at the organization of this meeting to bring it to the successful culmination which it promised to attain. "Not the least successful feature," said His Royal Highness, "is the large number of distinguished guests whom it has attracted from overseas. To all of these I wish to offer a most cordial welcome with the sincere hope that they may always carry with them, as I shall myself, the most pleasant recollections of a memorable gathering."

The Ordinary Man and the Poet.

By F. A. Hampton.

How the poetic temperament is to be explained is a fascinating psychological problem, but the following study suggests that there is probably little difference in kind between the ordinary man and the poet.

It has been said that every man has it in him to write one poem, and if this pleasant theory be true—as well it may be—then there would seem to be not much difference in kind between the ordinary man and the poet. Yet there is a difference of some sort, which is quite generally recognized, though it is easier to feel than define it.

Perhaps the difference may lie, after all, in the apparently trivial distinction that something forces the poet to make his poems public, while something equally strong keeps the ordinary man's one poem locked in his bosom. For if those of us who are not avowed poets will look into our own experience we shall find that this inhibiting factor is very strong indeed. There must be many who have thought out a poem, have even written it, and then felt a certain shrinking, a kind of modesty, which has made the thought of exposing a private emotional experience to the world actively disagreeable or, more likely, suppressed it altogether.

It is otherwise with the poet, and sometimes we feel a little wonder, perhaps mixed with a faint distaste, at the freedom with which the poet exhibits that inner emotional life that most of us so carefully conceal. It is usually the minor poet who attracts our attention in this way to his personality, for (if we may venture upon the definition of a minor poet) he fails to lift the emotion out of a purely personal "frame of reference" into a universal mode of expression.

It may strike an ordinary man who, modestly or defiantly, classes himself amongst the philistines, that the poet overrates the importance of his own feelings and reactions to the world; it is certain that he devotes to them an interest and attention which more commonplace people turn outward on to their fellow creatures and the ordinary business of life.

Here we seem to have a clue to the poetic temperament, for this self-interest carries feeling with it and gives rise, inevitably, to that form of self-love for which recent psychology has coined the term "Narcissism." Narcissus did not fall in love with himself until he caught sight of his image reflected in a well, but it is reasonable to suppose that we all begin life with our feelings attached to ourselves, looking upon ourselves as the centre of our small universe, and only little by little do we project our feelings on to our fellow creatures and the greater world.

The detachment of feeling is never complete, and we all retain a modicum of our early self-love; the poet seems to retain more than others, and it is not surprising that he should exhibit certain childlike traits of character or that children should sometimes give us thoughts and phrases that we recognize at once as the stuff of poetry. The child in the poet appears, of course, only in the emotional reactions, but though it may be obscured by intellectual subtlety it is fairly generally recognized and has been caricatured rather cruelly, by Anatole France in "Le Lys Rouge."

The Theme of Mortality.

The poet's attitude towards death is probably, as the writer hinted in a former article in these pages,* a reflection of his self-love. The ordinary man is too occupied with living to give much thought to death, but poetry has always been preoccupied with this sterile, obvious fact of mortality. There is hardly a great poet who has not written upon the transience of all that is good and beautiful and desirable. Yet it is a thought that hardly ever strikes the ordinary man, and we can scarcely escape the conclusion that it

* "The Fear of Death." *Discovery*, Vol. III, p. 285.

is the poet's own mortality and impermanence that he is lamenting.

The English lyrical poets of the Middle Ages were quite frank about it :—

" This worlde to me is but a cherry-fair,
All thingis passeth and so must I al-gate."

All the beauty that Francois Villon poured out for the dead ladies and " les gracieux galants que je suivois au tems jadis " was surpassed in the shuddering sincerity of the ballad that he wrote upon his own death in the shadow of the gibbet.

It was the fear of death—for himself—that wrung from Thomas Nashe the unforgettable beauty of :—

" Brightness falls from the air ;
Queens have died young and fair ;
Dust hath closed Helen's eye ;
I am sick, I must die—
Lord, have mercy on us ! "

It is an easy commonplace that love has produced more poetry than any other emotion, but whether it has produced more great poetry is by no means certain. When we think of the great poems, those that have stood the test of time and stamp themselves upon our memory to-day, it is remarkable to find how few are inspired by love and how many by death.

The Theme of Love.

When we read through the better, more permanent sort of love poetry, we find the praise of the beloved and the outward sweep of a great emotion a less common theme than the poet's disprized love and his wounded heart or vanity ; and it seems as though some reflux of the emotion of love back on to the poet were necessary to provide the driving force of poetry. It is, perhaps, the self-forgetfulness of the plain man in love that robs his poetry of its wings and prevents it from soaring into the company of the great ones.

It is not, of course, to be assumed that self-love alone will make a poet. Narcissus may be no more than a frigid hedonist or, if his self-love is complete and exclusive, he may be insane. For self-love plays a very large part in the severe types of mental disorder —a fact which may explain the not infrequent co-existence of poetic genius and insanity. It is certain that the complacent and self-satisfied lover of himself will never be a great poet. There must need be a dissatisfaction ; a striving, as it would seem, towards an ideal self and towards a perfection of beauty, imagined, perhaps, but hardly to be distilled from the experiences of this world. Here we may explain that the attribution of self-love to the poet is in no way derogatory, since it breeds not necessarily egoism but the unsatisfied pursuit of an ideal from which most ordinary men are comfortably free, but without which the world would be the poorer.

The orientation of feeling inwards toward the self produces not only a subjective attitude, but that enhanced sensitiveness which is so characteristic of the poet. By this sensitiveness the poet can reveal to others aspects of beauty not easily perceived or recognized by duller senses. But it entails upon its possessor a keen realization of human suffering and the manifold discomforts of life ; and by referring to himself the sufferings of other people, feeling them himself, the poet is able to express in their fullness the heartache and unfulfilled desires vaguely, though painfully, felt by so many an ordinary man.

The poet's sensitiveness to pain, joining with that striving after perfection already mentioned, has created the great literature of escape through magic casements opening on the foam of perilous seas in faery lands forlorn, giving us a mirage vision, down the green hill athwart a cedarn cover, of sunny pleasure domes with caves of ice.

It may be objected that we have confined our attention to the lyric poet alone. But, as a matter of actual fact, when we speak of " poetry " in ordinary conversation we almost invariably mean lyric poetry, and it is in lyric poetry, rather than in epic or dramatic, that we find most strongly and purely that quite undefinable quality that we easily recognize as " poetic." The epic and dramatic poet is bound to turn so much of his feeling outward on to his subject that, if our theory is correct, we should expect his work to be less characteristically " poetic " (in the everyday sense of the word) than that of the lyric poet.

These notes have no vaulting ambition to explain what poetry is or to enumerate all the gifts and penalties that go to the making of a poet. Their object is no more than to formulate what others besides the writer feel to be some of the chief characteristics of that poetic temperament which has been sometimes derided and sometimes overpraised.

Under the Microscope.

PREVIOUS articles in *Discovery* on animal life seen under the microscope, by Sir Arthur Shipley, are :—

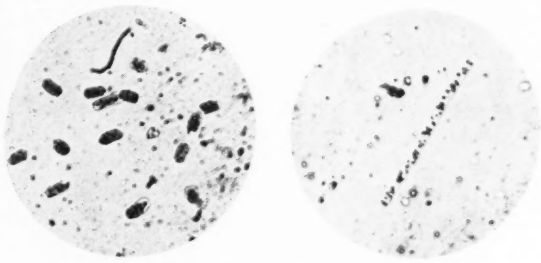
" Paramoecium or the Slipper Animalcule." Vol. 5, p. 120.
" The Vorticella or Bell-Animalcule." Vol. 5, p. 174.
" Rotifers." Vol. 5, p. 286.
" Flagellates." Vol. 6, p. 33.
" The Hydra or Fresh-water Polyp." Vol. 6, p. 60.
" Water Fleas." Vol. 6, p. 93.
" Cyclops." Vol. 6, p. 191.
" The Volvocinae." Vol. 6, p. 392.
" Ostracods." Vol. 6, p. 436.
" Rhizopoda with Shells." Vol. 6, p. 475.
" The Larvae and Pupae of Mosquitoes." Vol. 7, p. 139.

Sulphur-Bacteria and Water Pollution.

By Professor David Ellis, D.Sc., Ph.D.

Since the sulphur-bacterium includes in its diet the sulphuretted hydrogen gas liberated into water by decaying organic matter, it is a particularly important organism to the water engineer in discovering sources of pollution, as in the case of investigations lately undertaken by the author in one of the Clyde docks.

THE name sulphur-bacteria is bestowed on a class of organisms characterized by the possession within their bodies of droplets of sulphur. Each droplet looks, under the microscope, like a ring of ink drawn with a broad-pointed nib (Figs. 1 and 2). When



FIGS. 1 AND 2.
SULPHUR-BACTERIA SEEN UNDER THE MICROSCOPE.
(*Left*)—*Chromatium okenii* (× 390). The sulphur droplets are clearly seen in the cells, each like a circle drawn in ink.
2 (*Right*)—*Beggiatoa alba* (× 560). A thread-like form and the most widely-distributed species.

the conditions are good the organisms appear very fully loaded with sulphur droplets, and it is only under rare circumstances that they are totally absent. For this reason, in a mixed field of micro-organisms, the sulphur-bacteria can be picked out with ease, for it needs only a single glance to be able to identify the sulphur globules, so different are these bodies from the other constituents inside the organism.

In order to understand the reason for the appearance of sulphur within the bodies of these bacteria we must look to the mode of nourishment for a solution. All organisms, animal and vegetable, must derive nourishment by the absorption of the raw materials in their immediate neighbourhood. Such materials are drawn within the organism, and become incorporated into the living matter or protoplasm of the cell. As a result of the ingestion of food, energy is liberated and the organism is able to carry on the business of life. The human machinery is kept going by the absorption of organic matter, and most organisms—including man—are limited to one method of food assimilation. Now some of the sulphur-bacteria possess no fewer than three distinct modes of obtaining food. In virtue of the possession of a purple colouring matter they are able to assimilate the carbon dioxide of the atmosphere, as do the green plants, and utilize the energy of the sun to build up from this and other materials, complex organic substances which can subsequently be broken down and supply energy in the process. Then they are able to feed directly on the organic matter in solution in the water in which they live, and utilize it as is done in the human machinery. Finally, they appear to have the power to assimilate the hydrogen sulphide gas which is liberated into water by the bacterial decomposition of organic matter and derive energy by the conversion of this substance first into sulphur and later into the sulphate form. The sulphur globules in the cell are thus transitional forms in the conversion of the sulphuretted hydrogen to the sulphate. The sulphur-bacteria are not all coloured, and in such forms the sources of energy are confined to the second and third modes given above. We must, however, at this point state that some investigators deny that energy is obtained by the conversion of the sulphide into the sulphate. Be that as it may, it is quite certain that

FIG. 3.
VIEW OF THE CLYDE BELOW GLASGOW.
As explained in the text, investigation has shown that the black sand of the foreshore is not directly due to pollution.

the sulphur-bacteria *thrive only where organic matter is present*, and also that their identification is a simple matter. The sulphur globules, once recognized, can never be mistaken for anything else, and the quest for sulphur-bacteria resolves itself into a search for

organisms of the proper dimensions, containing in their bodies round little bodies each looking like a ring of ink drawn with a broad nib. Again there is the further advantage that among micro-organisms of their own class, the sulphur-bacteria are most of them of gigantic dimensions, and their recognition is not difficult of accomplishment. Finally, attention must be drawn to the fact that as indicator-organisms the sulphur-bacteria possess the advantage over ordinary bacteria, which is conferred on them by the fact that identification is possible without the necessity of making plate- and tube-cultures that are involved when an organism, e.g., *Bacillus coli communis*, is used as an indicator. At one time or another some 2,000 species of the genus *Bacillus* have been described, and all look very much alike under the microscope. The use of one of these as an indicator organism involves a somewhat complicated procedure, and some knowledge of the technic of bacteriology. This is not necessary in dealing with the sulphur-bacteria, for the identification of which all that is needed is a high-power microscope, to which must, of course, be added a knowledge of the use of this instrument.

Life History.

By far the most important, as well as the most numerous and the most widely-distributed of the sulphur-bacteria is *Beggiatoa alba*, a photo-micrograph of which is shown in Fig. 2. In nearly every case in which the sulphur-bacteria appear in water as a result of organic contamination it is this organism that is found. It will therefore serve a useful purpose if we give a slight sketch of its life-history, and of the conditions that determine its presence. It appears in shallow pools, both marine and fresh, to which additions have been made of organic matter in a state of decomposition. This organic matter may take the form of sewage, or it may have been derived from the decomposition of animal or vegetable matter. The water in which it appears is almost invariably clear and apparently pure and fit to drink. To the expert the presence of this organism is indicated at once by the appearance at the bottom of the pool of a greyish felty covering usually covering solid organic matter, either in the gross form or in the form of finely divided matter lying on the bed of the pool. The presence of this covering should at once condemn the water if destined for consumption, however clear and limpid it may appear to the eye. If some of this felt be examined under the microscope, forms such as are figured in the accompanying illustration (Fig. 2) will at once be made manifest. The thickness of the threads is on the average about $1\frac{1}{2}$-2 μ ($1\ \mu = \frac{1}{1000}$ m.m.), but slimmer and also thicker threads may obtain. The same variation is found in the length of the threads, for whilst some are short, others are very long; some may show motility, moving through the field with a slow and somewhat stately movement. All will agree in the possession of the inky-black rings with a clear centre which we have described; the ends of the threads are rounded, no sharp corners being anywhere visible. A little study of the organisms will reveal the fact that when they multiply they do so by the simplest of all methods known in biology, namely, by fission and subsequent elongation of the fissured segments. The threads are not divided up into compartments, each organism containing only one cavity. There appears to be a coat of darker material on the outside of each thread, doubtless for protective purposes; inside this membrane we find, besides the sulphur globules, the living matter or protoplasm, which is, as it were, the responsible agent for everything performed by the organism, and the various raw, waste, and reserve materials which are inseparably associated with life in whichever form it may become manifest. These, however, will not be separately seen, and mention is made of them merely to call attention to the fact of their existence.

If a little of the grey felty covering, along with some of the water from the pool, be put into a bottle and corked up, a very curious phenomenon will be observed which has great interest for us, because it explains a phenomenon which often occurs in Nature and of which little study has hitherto been made. If the organisms be examined under the microscope a few days after being bottled up, they will be found to have changed in character. The sulphur globules will have been used up, so it is evident that a period of starvation has set in, and the organism has in consequence been compelled to use up its reserve store.

A "Thinning-out" Process.

Then, a day or two later, an extraordinary change will be observed. Most of the threads will have become split up into compartments by the formation of what appear to be transverse walls. If these threads be kept under continuous observation each compartment will be seen to swell up into a rounded mass (see Fig. 4) the swelling continuing until the organism *disappears altogether*. If properly watched the complete dissolution of a thread may be observed from start to finish. It is evident, therefore, that in Nature the same procedure must be constantly taking place. Water engineers are often surprised to find that certain mass cultures of organisms that have appeared in their pipes, and which have

been a cause of worry, disappear completely within a short period of time. The fact is that micro-organisms finding at a certain time very favourable

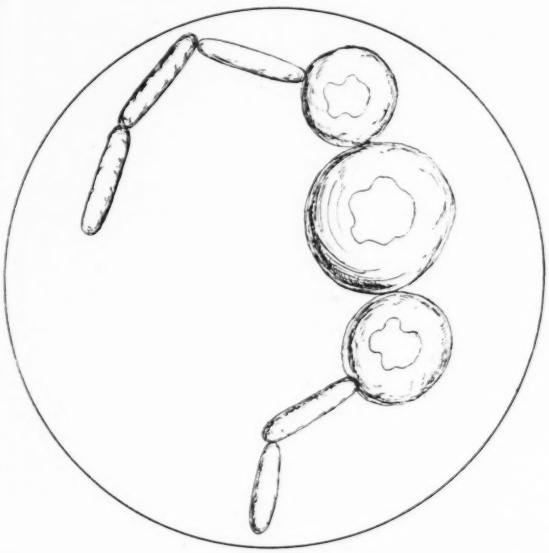


FIG. 4.
HOW SULPHUR-BACTERIA BECOME THINNED OUT.
Beggiatoa alba (× 720) in process of dissolution. The separate parts were originally a single one-celled thread. The three cells seen in the swollen state are about to disintegrate.

conditions of growth, multiply with enormous rapidity, so much so that they soon become faced with starvation. If a number of organisms multiply in the same rapid way, there would very soon be a congestion that would make life insupportable. It is clear therefore that in Nature there are forces which begin to operate when undesirable conditions supervene. One combination of forces may be seen at work in the sulphur-bacteria under unfavourable conditions. They simply disappear as entities, and the matter that was in them becomes an addition to the stock of the raw material which is the basis for the breeding of future generations of micro-organisms.

It may be asked how such organisms are able to reappear periodically in the same spots if they thus completely destroy themselves. There can be little doubt that at some period in their lives provision is made for this by the formation of special reproductive cells capable of resisting destructive agencies. The writer has found such special cells in two species of the sulphur-bacteria (*Beggiatoa alba* and *Thiophysa volutans*), and doubtless the same formation is a characteristic part of the life-histories of other species.

If we consider the facts to which we have alluded above, we shall see that it is possible to make use of the sulphur-bacteria as supplementary aids in coming to a conclusion regarding the sources of pollution in any particular area.

Indicators of Pollution.

The following example of a specific case may serve by way of illustration. On the banks of the Clyde there are areas where the sand of the shore is quite black (seen in Fig. 3) an inch or so below the surface. In an estuarial river, like the Clyde, receiving the sewage of a town of over a million inhabitants, and the garbage resulting from its huge traffic in ships, as well as contributions from decomposing animal and vegetable remains, there are several possible sources to draw from in explaining why some particular organic matter should be found in any specific place. It is possible to indict the sewage as the chief agent responsible for the blackening of the sand, and to maintain that the other agencies are of a subsidiary nature. If this view were, without further challenge, accepted, it would be possible to bring a serious charge against the authority or authorities responsible for the disposal of sewage matter. The writer has recently been engaged in making observations and experiments to ascertain which source of organic matter is chiefly responsible for the production of this blackness in the sand of the Clyde. To enable him to come to a conclusion, it was necessary to take up the matter of sewage pollution and attempt to connect its incidence with the formation of blackness in the sand. Certain specific points where the black colour was most prominent were taken and subjected to a bacteriological scrutiny. It was found that wherever a pronounced sewage contamination of a local character was made manifest, there the sulphur-bacteria—in particular *Beggiatoa alba*—appeared in great abundance. At one place the appearance of the sulphur-organism seemed to establish a connexion between the blackness in the sand and the incidence of sewage pollution. The *Beggiatoa*, however, was shown to have owed its existence to the presence of direct sewage contamination from some neighbouring houses. The presence of *Beggiatoa* on the Clyde was not demonstrated in a single instance without the simultaneous concurrence of a direct sewage contamination. This is not to imply that the appearance of *Beggiatoa* indicates the existence of sewage contamination in every case where it is observed, for this organism appears frequently wherever animal and vegetable remains are decomposing under certain conditions. But it does mean that if its presence be noted in a stream

meandering through a tract of sandy or stony waste, or under analogous conditions where animal and vegetable remains are obviously absent, the presence of sewage contamination is indicated. A good use may be made of a knowledge of this fact, because the fact of sewage contamination is known immediately, and the sanitary inspector or chemist who observes the appearance of the sulphur-bacteria can take the next step in his investigation under the certain knowledge that sewage pollution is present.

An Investigation on the Clyde.

One interesting case arose from the writer's examination of one of the Clyde docks. At this place the presence of *Beggiatoa alba* was noted, the threads being present on the surface of the wooden piles which flanked the entrance to the dock in extraordinary profusion. As there are no organic remains in a state of decomposition on these wooden surfaces, there was no way of accounting for the presence of *Beggiatoa* except on the assumption of sewage pollution. It was found on inquiry that the dock was the recipient of a direct discharge of sewage from the immediate neighbourhood. Here again, given certain conditions, it was found possible without making a complicated bacteriological test to deduce the certainty of sewage pollution. It is, of course, highly important to be certain in cases such as the above that other sources of pollution have been ruled out, and a great error would be committed if it were at once assumed that the presence of *Beggiatoa* spelt sewage pollution. Thus, if a growth be found in a pool among rocks covered with seaweed, and if the pool contains decomposing seaweed, it is useless trying to establish a case for sewage pollution on such evidence. Under such conditions the organic matter needed for the sustenance of *Beggiatoa* is obviously adequately supplied by the decomposing seaweed. If, however, the observer is satisfied that the water, although clear, contains sewage pollution because there is no other way to account for the growth of *Beggiatoa alba*, he can then proceed to make the more extended experiments which will give him more accurate information in regard to the degree of pollution. Such experiments usually take the form of ascertaining the number of bacteria in the water per unit volume, and the number of these which belong to the species *Bacillus coli communis*. He will have the satisfaction of knowing that he will not be making experiments in the dark, and that his analyses will show positive results in regard to the incidence of pollution.

We may, incidentally, note that this blackness in the sand is not due, except in an indirect way, to organic matter. The blackness is absent from the surface sand because it suffers oxidation, and the substance which suffers oxidation, in the Clyde estuary at any rate, is ferrous sulphide. We have made mention of *Beggiatoa alba* in particular because of its prominence in waters of the kind that is usually a matter of concern to the sanitary engineer and to the chemist; but there are many other species. Space does not, however, permit of their description in detail. It will suffice here to state that there are many others belonging to the same group, and some of these may be encountered in waters polluted through human agency. It may, in conclusion, be well to point out that the mind must not be too steadfastly concentrated on one particular type of appearance in making an examination under the microscope. It often happens in Nature that the growth of certain micro-organisms is extraordinarily rapid when circumstances are very favourable; and in such cases the observer must be on the look out for divergences from the usual method of propagation. For example, suppose an organism normally propagates by elongation followed by fission and separation of the fissured parts. If the rate of fission be speeded up, the resulting organisms will be very short. On the other hand, if the process of elongation is speeded up, longer organisms will result. The observer must always be prepared for a certain amount of divergence from the normal. The only advice that can be given is to gain experience by constant observations under the microscope.

A Progressive Swiss Observatory.

THE extensive use which is now being made of research facilities for testing materials destined for industrial use was recently illustrated in the sending of samples of rubber from this country to Switzerland to be tested for moisture adsorption. This was undertaken by Dr. Kollicker, the Swiss Government astronomer, at the observatory situated over 11,000 feet above sea-level, 2,000 feet or so beneath the crest of the Jung-frau mountain in the Bernese Oberland. Here weather conditions and atmospheric effects are studied, the station being fitted with a high-power telescope* for astronomical research. During the summer this is frequently used for sweeping the mountain side in search of belated travellers, thousands visiting the Jung-frau observatory to obtain the view which extends beyond the French Vosges mountains to the Black Forest in Germany.

*The telescope with Dr. Kollicker (right) is seen in this month's cover illustration.

The Composition of the Upper Air.

By C. Britton, B.Sc.

Meteorological Office, Shoeburyness.

In our June issue Lt.-Col. Stratton pointed out the importance of the work done by astronomers during solar eclipses in indicating the part played in our lives by solar radiation. In studying solar radiation, a consideration of the role of the earth's atmosphere is also necessary, as the author shows in discussing the interesting problem of its composition.

It is not too much to say that the factors of prime importance to terrestrial life are the light and heat of the sun. Climate, and all the far-reaching effects of climate, are topics of paramount importance in the history of civilizations, and climate is a phenomenon which is essentially a result of the solar heat. And indeed all weather is ultimately traceable to the unequal warming of the earth's surface by the solar radiation.

The light and heat of the sun reach this globe in the form of radiant energy transmitted across the interplanetary space. It is important to notice that this energy, before it reaches the surface of the earth, has to pass through the earth's atmosphere. Now the thickness of the atmosphere is considerable, and a part of the energy of the radiation will be absorbed in the atmosphere and the remainder will eventually arrive at the surface. The part of the radiation that will be absorbed depends on the nature of the medium through which that radiation passes, so that the composition of the atmosphere, and especially of the upper layers, is a matter of fundamental importance to humanity. For it is these constituents of the atmosphere which partially eliminate from the radiant energy emitted by the sun those radiations which might be directly harmful to life. These harmful wave-lengths are known to lie in what is called the ultra-violet part of the spectrum.

The Problem Stated.

Now the sun is an incandescent body at a high temperature and emits other forms of energy besides those of light and heat. These other forms consist of charged particles of various velocities. Some streams of these particles reach out as far as the earth's orbit, and it becomes important to ascertain what happens to them when they enter the earth's atmosphere. Are they all absorbed before they reach the surface and, if so, are there any resulting phenomena to shed a light upon the problem of the physical state and the composition of those upper layers of the ocean of air which seem so remote and inaccessible to us, who live at the bottom of it ?

Speculation has not been wanting in the history of science as to what these upper layers were composed of. Most of the earlier efforts, however, were purely conjectural. The writer has seen an article in a serious journal, under a date not a hundred years ago, wherein the hypothesis is suggested that the upper layers are composed of hydrogen in a state of combustion, thus accounting for the blue colour of the sky ! Almost the whole of the connected and logical work on the topic, however, is to be found in the present century.

A Fundamental Discovery.

The first step on the road was rendered possible by the discovery by M. Teisserenc de Bort of the fundamental fact that, as we ascend in the atmosphere, the temperature does not continue to fall off indefinitely but that we arrive at a certain height, after which the temperature remains almost stationary as we go higher. This discovery is one of the most important in the science of meteorology, and much of the modern development of that science dates from this discovery. The height of this dividing plane, called the tropopause, varies with the latitude, but is on the average about six miles.

The composition of the surface layers of the atmosphere is sensibly constant. Were it not so, life would be difficult and precarious. An important factor in ensuring this constancy of composition is the thorough mixing of the air produced by the winds and by convection. Now above the tropopause there is no mixing in the vertical direction in consequence of the constant temperature found in that region as we go upwards. Hence other factors will operate in determining the composition of the air in the upper layers of the atmosphere. There will be a tendency for the constituents to separate out into layers with the heaviest gas at the bottom, like a number of non-miscible liquids in a vessel. In this event we should naturally expect to find the lightest gas at the top. Now the main constituents of the atmosphere at the ground are, of course, nitrogen and oxygen, the latter being the essential element for the maintenance of life and the nitrogen being

present chiefly as a diluent. But there are also small quantities of a number of other gases, the lightest of these being hydrogen and helium. The question arises as to whether a layer of one or other of these light gases floats at the top of the atmosphere almost unmixed with the heavier gases found at the surface.

Professors Chapman and Milne, in a notable contribution to the literature of the subject in 1920, suggested reasons for thinking that, above the tropopause and up to a height of about 120 miles, nitrogen is the predominant gas, and that above 120 miles the light gas helium preponderates up to the very utmost limits of the atmosphere. It is to be noted that hydrogen does not come into this scheme at all.

The Aurora Borealis.

Professor Vegard, however, had been tackling the subject along experimental lines, and he had been making use of a phenomenon that actually had its seat in the regions under discussion. The aurora is not often seen in these middle latitudes, but occasionally well-defined displays have been seen in London. A very fine one was widely observed on 9th March of this year. In polar latitudes, however, it is of very frequent occurrence, and it was at Bossekop that Professor Vegard was conducting his researches. These researches have led him to remarkable conclusions. The experiments had two main objects in view. The first was to measure the height in the atmosphere at which aurora occurred and the second was to analyse the auroral light by the spectroscope, in order to ascertain whether any information could be obtained as to what the atmosphere was composed of at those heights. Both branches of the research are important from our present point of view.

The method of obtaining the auroral heights was an ingenious one, but does not concern our immediate object. It is of importance to note, however, that streamers of aurora have been found extending to a height of 400 miles. The analysis of the light emitted by the aurora yielded the result that the green luminosity of the phenomenon was due to nitrogen. Numbers of auroral streamers were examined and the same result was obtained along the whole length of the streamers, some of which reached a height of 300 to 400 miles. Careful measurements were made of the lines in the spectra, three spectroscopes of various types being used. The spectrum of the auroral light proved to be very similar to what is known as the negative band spectrum of nitrogen. There was, however, one very notable difference. The brightest line of all in the auroral spectrum was not to be found in any laboratory-produced spectrum of nitrogen. A very important point is that no vestige of the spectra of the light gases hydrogen and helium were found in the course of the experiments, which would seem to prove that, in any case, those gases could not form more than a very small proportion of the upper strata. This was contrary to existing hypotheses.

In the winter of 1922-1923, Professor Vegard continued his researches at Tromso and the result of many more spectroscopic observations was to confirm all his previous results. He then formulated the hypothesis that the whole of the upper atmosphere is predominantly nitrogen and that all the light gases formerly supposed to be present were absent. The light of the aurora was due to the bombardment of these outer layers of the atmosphere by streams of charged particles from the sun. The discrepancy of the bright line in the spectrum of the aurora was explained by Vegard as being due to the fact that we had not yet secured in the laboratory nitrogen in a state similar to that of the upper strata of the atmosphere.

The question at once arises, what is the nature of this state? As a result of his investigations, Vegard suggested that the nitrogen is not present in the gaseous state, but in the form of minute molecular aggregates, to which he gave the name "nitrogen dust." In other words, the nitrogen exists in a modification of the solid state! It is therefore suggested that we must expect an unusual nitrogen spectrum because of the unusual state of the nitrogen involved in its production.

A New Theory and its Criticism.

This is a new departure and breaks new ground, and yet it is clear that an unusual hypothesis was required to explain the facts, and also that further experiments should be carried out if possible to test the conclusions. Such a series of experiments has now been made by Vegard, and he is satisfied that his results all go to confirm his hypothesis. He made as near an approach as possible to the actual conditions of the upper atmosphere by submitting solid nitrogen at a low temperature to the action of a stream of cathode rays. The resulting luminosity was found to yield a spectrum very like that of aurora and which included the prominent bright line as well. The experiments were extended to sets of varying conditions, and a number of other results of scientific interest were obtained.

To sum up, we may say that his conclusion is that the "top" of the atmosphere is composed of nitrogen in the special condition of small clusters resembling the solid state. The streams of electrified particles from the sun on entering the atmosphere are absorbed

by this layer and prevented from reaching down to the earth's surface. An outward and visible sign of the presence of the particles and the nitrogen layer is the appearance in the sky known as the aurora.

Professor Vegard's unusual hypothesis has met with considerable criticism in this country, both on theoretical and practical grounds, especially as it has been found that a suitable mixture of the gases oxygen and helium, bombarded under proper conditions by electromagnetic particles, will give the typical bright green spectral line of Aurora Borealis. The gaseous composition of the outer layers of the atmosphere still, therefore, remains a matter of some doubt, although it seems fairly certain that no hydrogen is present in those regions.

The active gas known as ozone has received much attention recently, and means have been devised whereby the quantity of it present in the atmosphere may be measured from day to day. The amount is found to be very much greater than would be expected, taking into account the exceedingly minute quantities of this gas found in the air near the ground. There is thus a large admixture of ozone to be accounted for, and this is probably located also in the inaccessible upper regions of the air. A considerable part of the ultra-violet radiation of the sun is absorbed by this ozone in the upper air.

Correspondence.

ANOTHER "GROMA" DISCOVERED.

To the Editor of DISCOVERY

SIR,

It may be of interest to readers of the article on the ancient surveying instrument "the Groma," in the September, 1925, issue of *Discovery*, to learn that a further specimen—so far as is known, the second in existence—has now been brought to light.

While looking through a miscellaneous collection of objects at the Egypt Exploration Society's Headquarters, I recently came across a Groma consisting of two roughly shaped rods tightly lashed at the centres at right angles by a piece of rope made of datepalm fibre. Near the ends of the rods are in-cuts marking the position of the plummet strings which hung originally from the ends.

This Groma was brought from the Fayum (a district fifty miles south of Cairo) in 1899, and up till a few weeks ago lay unrecognized amongst a number of fragments undisposed of. It probably dates from the Graeco-Roman period.

The specimen has been acquired by the South Kensington Museum authorities, and will shortly be exhibited there.

Amersham, Bucks. Yours, etc.,
12th August, 1926 R. W. SLOLEY.

A COLOUR PHENOMENON.

To the Editor of DISCOVERY.

SIR,

Discovery is the only scientific journal I read, and I shall be grateful if you, or any of your readers, will give an explanation of this phenomenon.

On a wooden shelf, painted white enamel, in front of a window which does not open, and is water-tight, a coloured batique silk scarf was laid, on the night of Sunday the 18th July, and on Monday morning the colours were so imprinted on the enamel that they could not be rubbed out, while the scarf had received no apparent damage. There was no damp on the shelf. The closed window faces east. There was an open window at the opposite end of the room, facing west. There was a severe thunderstorm, with vivid lightning, that night, from the east.

Yours faithfully,
St. John's Manse, Newton Stewart. W. H. BROWN DOUGLAS.
20th July, 1926.

The Editor submitted the foregoing letter to Dr. A. S. Russell, M.C., who suggests that the scarf acts similarly to a typewriter ribbon, in giving up colour without apparently losing it.

"Batique is not 'dipped,'" Dr. Russell writes, "but is a 'print,' *i.e.*, the colours are applied to the surface. A new batique scarf might probably have superfluous colour, easily removed.

"The colour is 'adsorbed' on the linseed oil which is contained in the enamel and is therefore almost irremovable. Moisture is not necessary for this 'adsorption.' The colour could only be removed by removing the enamel, 'adsorption' being really a very tenacious gripping effect. The details in the three last sentences of Mr. Brown Douglas's letter are irrelevant to this explanation.

"Your correspondent might test this view by exposing a typewriter ribbon (containing aniline dye)—even an old dried one—as he did the scarf. The ribbon will appear unchanged but the enamel will be coloured."

ORIGIN OF THE WORD "TELLAR."

To the Editor of DISCOVERY.

SIR,

I was much interested in Mr. Jenkins' letter, in your August issue, arising out of my article on "The Woodman and his Craft."

The difficulty is that the word "Tellar," as now used, denotes any tree which is not to be cut, and is not confined to chestnut; nor does a "tellar" occur at any definite interval in the cant. They may be trees grouped close together or dotted at any distance over the cant. Still, it is certainly possible that in the old days of the craft trees may have been left for the purpose of checking or "telling" the numbers cut, and the term which applied to them became more elastic in later ages. The dimensions and boundaries of the cant are marked by the woodreeve cutting a narrow strip of small wood between two cants before the sales take place. I am obliged to your correspondent, and intend to pursue investigations with his remarks in mind.

I am, Sir,
Gloucester. Yours, etc.,
August, 1926. G. L. JARRATT.

[*A further letter on this subject appears on page* 324.]

A Visit to a Turkistan Monastery.

By Lt.-Col. P. T. Etherton.

Author of "Across the Roof of the World."

Sometime H.M. Consul-General and Political Resident in Turkistan, the author describes a sect of Buddhists who live in the little-known Karakoram Mountains and observe the fanatical practices of their ancient religion.

THE ring round the unexplored portions of the earth is gradually being tightened; year by year we penetrate farther into the unknown, and soon there will be little left for geographical Alexanders to conquer. Yet the heart of Asia, that vast territory we vaguely term Turkistan, is still very much of a sealed book to the rest of the world, for there we come into contact with strange tribes and weird customs that are as marvellous as an Eastern fairy tale, and at the same time both new and true.

BUDDHIST PRIESTS AT ONE OF THE MONASTERIES IN THE KARAKORAM.

Amidst the recesses of the Karakoram Mountains, which form the dividing line between India and Turkistan, are many narrow valleys and ravines shut in by rocky walls towering sheer into the skies. Their exact geographical position is difficult to define, for this mountain maze has been scarcely explored, but some of the highest peaks of the world are within its confines, and access to its innermost valleys is barred by raging torrents. The particular valley to which I refer lies some three hundred miles south-west of Yarkand, in Turkistan, a city that was the capital of ancient Tartary before the Christian era. To reach this valley we must cross the ravines of the Yarkand River, through canyons which, for savage grandeur and immensity, dwarf those of the American Rockies. There we find a quaint tribe of Buddhists completely shut off from the world beyond and from the onward march of progress who, locked in amongst their mountain fastnesses, devote themselves to a life of the most rigorous austerity and self-denial.

This religious sect, numbering not more than six hundred, are doing penance for the rest of the world; they are devout followers of Gautama Buddha who, five centuries before the birth of Christ, found his way into India and there preached the gospel that later on was to control the destiny of so many millions throughout Asia. They represent perhaps the purest form of the Buddhist faith, for in spite of the sincerity of the Buddha's teaching, and his single-mindedness, the creed he advocated became perverted, and from it sprang Lamaism, with spiritual and temporal headquarters at Lhasa in Tibet, where is found the Grand Lama and the reincarnation of the Deity, one so holy that he is never seen except by his immediate entourage.

Much could be written of the life of the sect, many of whose members have vowed to remain for ever secluded and not to see again the light of day. It is religious fanaticism carried to extremes, for they have chosen to live in cells cut out of the solid rock, food and other necessaries being passed through a slight opening in the rocky chamber. Otherwise the cell remains closed and has no communication with the outer world; in winter the thermometer drops to twenty degrees below zero, in summer there is corresponding heat in these narrow ravines, yet some of these devotees

pass ten years or more walled up alive. As an illustration of the fanaticism inherent amongst the monks, a festival may be mentioned at which it is the custom to prepare soup in huge cauldrons for pilgrims who gather there once in seven years. The cauldrons are nine feet or more in depth, and nine to ten feet wide—history does not tell us how these immense bowls were brought into the valley—and, as the final act of devotion and piety at this ceremony, the most aged monk would plunge into the boiling cauldron. The sequel to this was the rush on the part of the pilgrims to secure a taste of the soup, for not only did it cleanse them from all unrighteousness, but carried with it a passport to Valhalla.

The discipline of the monastery is in keeping with the general austerity of their lives, for those monks who are not actually occupants of the rocky cells rise at dawn summer and winter and are engaged almost throughout the entire day in prayer and devotion. In the monasteries in Mongolia, of which those in the Karakoram are branches, the medical calling is popular, since it affords an opportunity of acquiring wealth and status amongst the people. Professional knowledge is founded on superstition and witchcraft, and there are quaint observances respecting doctor and patient ; one is that the medico takes up his residence at the patient's tent and remains there, doing himself well, until the sick person is either cured or passes beyond mortal ken. Payment of the debt incurred is by results—a method of liquidating that might appeal to the Western mind.

The mode of punishment amongst these people of the cloisters and the camp displays terrible ingenuity. The prisoner is placed in an oblong box, measuring about five feet by two, and two feet in depth, the counterpart of a coffin, and there, chained and manacled, is left to pass weeks, sometimes months and not infrequently years, according to the extent of the crime. They can neither stand up nor lie down, but must perforce assume a semi-crouching posture, with the result that their limbs become shrunken and useless, and after a time they are nothing but shrivelled wrecks from the constant agonizing position to which they are exposed. They are taken out for a few minutes daily, and food is passed to them through a small hole in the side of the box. For covering at night a thin worn blanket is given, this being exchanged in winter for a sheepskin coat, totally inadequate as bedclothes, especially in the severe winter months. Indeed, it is almost incredible that a prisoner survives the torture of this coffin, the disgusting food, and the unspeakable filth.

A BUDDHIST MONASTERY IN THE KARAKORAM MOUNTAINS.

The cells are cut into the mountain-side.

CROSSING THE YARKAND RIVER.

Amongst the pilgrims who annually come down to the monastery in the Karakoram are the Kalmuks, a Buddhist tribe remarkable for their peculiar manners and customs, more particularly in regard to the disposal of the dead. Instead of burial in the orthodox manner the body is put out on a knoll or low hill in the vicinity of the camp, and there left to the tender mercies of dogs and birds of prey. Should the remains not be disposed of within a few days the deceased is considered to have led a wicked and wayward life, since even the animals are shocked and refuse to touch the body. The sequel to this discovery is a severe chastisement administered to all members of the deceased's family, with the idea of saving them from a similar fate—the sins of the father visited upon the children indeed !

The Kalmuks retain other customs and beliefs whose origin may be sought far back in the mists of antiquity. For instance, in the matter of marriage, this conservative tribe treasure the romantic theory that the bride must be carried off from her father's tent, and they cling to tradition in the unwritten code which permits of the young lady in question, when pressed by many admirers, adroitly confiding herself to the care of the one she favours most. The wedding that follows is a great event, especially when the belle of the encampment is the prize; mounted on a horse, the bride gives the lead in a break-neck race to the young men who have aspired to her hand, and to ward off undesirable suitors she uses a heavy whip with force and accuracy. Again, the Kalmuks drink "kumis," fermented mare's milk, from leathern bottles, in exactly the same way as the Jewish patriarchs and their nomadic forbears did centuries before them. Their great failing, in fact, is fondness for the flowing bowl, and I was once complimented as a great and sporting man because I had presented a bottle of cherry brandy to one of their headmen, on which he became completely intoxicated. There is no accounting for taste, nor is the path to fame beset with difficulties amongst these strange people, but they are an attractive race, especially for their love of sport.

Their ideas on natural history are refreshing; they tell you that a tree stands for one thousand years, after which it falls to the ground, where it remains another thousand years until it rots. They also assert that the fox is of black colour for five hundred years, and then turns white for a similar period when, having wearied of life and whiteness in that time, he gladly dies.

Turkistan and the Karakoram might well excite more curiosity, not only as to their physical geography, but on account of the interesting inhabitants of these backwaters on which the tides of civilization are beginning to encroach.

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The Amateur's Work in Astronomy.*

By Leon Campbell.

Harvard College Observatory, U.S.A.

Extensive work is now being undertaken by amateur astronomical societies in America. The following gives an admirable idea of the discoveries made in this field, describing how observations can best be undertaken.

THERE is much that has been done in the past by the amateur astronomer, and still more remains to be done which will greatly augment our knowledge of the stars. But it is all too true that many an enthusiast has invested in a fairly good telescope, amused himself with peeps at sun, moon, planets, stars, and perhaps at a visiting comet, and then, after airing his astronomical knowledge to his friends, has relegated the instrument to the attic. One who has made such desultory observations has only just begun to enjoy the pleasures of astronomy, for there are several fields of research open to the amateur with or without a telescope.

For the observer without a telescope, meteor observing offers a rich field of endeavour. When one realizes that millions of meteors enter the earth's atmosphere daily, some of them no larger than grains of sand, others large enough to light up the heavens even in broad daylight—as evidenced by the daylight meteor of the morning of 15th November, 1925—one perceives that there is plenty of work to be done in observing meteors; in counting them, in gauging their positions, and in estimating their brightness, especially during the occurrence of meteor showers.

If one watches any selected area of the sky on almost any clear night for, say, half an hour, he will doubtless be able to count several conspicuous meteors, and with little more than a passing knowledge of celestial topography, he can plot their paths, and thus furnish data for determining their radiants—the points in the sky from which the meteors appear to originate.

The American Meteor Society, under the direction of Professor C. P. Oliver, at the Leander McCormick Observatory, Charlottesville, Va., has gathered together a group of meteor observers, and new recruits to the ranks are constantly being secured. The work is easy, fascinating, and productive of real results.

Particular stress may be laid on the use of photography in securing valuable data on meteors. While this sort of work cannot be expected to supersede visual observations, it is obvious that when a meteor

* Substance of an address broadcast recently from the Harvard College Observatory and reprinted from the American *Scientific Monthly*.

trail is photographed, much more information can be obtained, owing to the fact that the photograph is a permanent record.

Discovering New Stars.

There is still another field which is open to the amateur who does not possess a telescope. Everyone has heard at one time or another about new stars, or novae, as they are generally called. Since the time of Tycho Brahe about fifty new stars have been discovered, and nearly a dozen of these have been first detected and later extensively observed with the unaided eye.

Tycho Brahe's nova, which appeared in the year 1572 in the well-known constellation of Cassiopeia, became as brilliant as the resplendent planet Venus at her brightest, and remained visible to the naked eye for many months. Several interesting novae have appeared in the heavens during the past twenty-five years, beginning with the brilliant Nova Persei in 1901. This was followed by Nova Geminorum in 1912, Nova Aquilae in 1918, and Nova Cygni in 1920. The most recent instance is that of the new star which appeared in May, 1925, in the southern constellation Pictor. Unfortunately for northerners, it was visible only in the southern hemisphere. This star reached the first magnitude on 9th June, and remained visible to the unaided eye for many months, undergoing numerous irregularities in brilliancy.

As an instance of amateur aid to science, it is of interest to note that all the bright new stars which have appeared in the present century were first detected by amateurs—amateurs whose familiarity with the brighter stars of the conspicuous constellations enabled them to detect the presence of a strange star early in its spectacular career. The Rev. T. D. Anderson, of Edinburgh, is an independent discoverer of several new stars, being the original discoverer of Nova Aurigae, in 1892, and of Nova Persei, in 1901. Mr. Richard Watson, of South Africa, was not only the first to see the recent nova in Pictor, but was one of the very first to see Nova Aquilae on 8th June, 1918. This latter nova was discovered independently by more than a score of observers, the majority of them being amateurs. Since most of the novae occur near the Milky Way, it might well be worth while for the amateur to familiarize himself with all the naked-eye stars of the constellations which lie along this well-known band of stars.

And now for the work to which the fortunate possessor of a telescope may devote his leisure moments. From earliest times comet seeking has proved an alluring diversion for both professional and amateur. Although in recent years many comets have been picked up from photographic plates in the hands of the professional, a large number have also been found by amateurs as the result of a definite search. The comet recently discovered in Boötes, first seen by Mr. L. C. Peltier, of Delphos, Ohio, was found by him several days before it was seen by any professional. This observer, in nine years devoted to astronomical observing, has found three comets, although only the last one proved to be an original discovery. Another amateur, the late Mr. William Brooks, of Geneva, N. Y., was the original discoverer of at least a dozen comets in some twenty years of observing.

A telescope of short focus and large field, with a low power eyepiece, is best suited to comet seeking, and if a comet becomes as bright as the ninth magnitude it will rarely fail to be detected. Although the discovery of comets may lead to considerable publicity, with even an occasional comet medal for new ones, the work is of far less importance to astronomical science than the branch of observing I shall mention next—the observing of variable stars.

American Amateurs' Society.

The better to explain this variable star work, something must be told about a most enthusiastic band of amateur observers—the society known as the American Association of Variable Star Observers, and called for short the " A.A.V.S.O." It is composed mainly of amateurs, and its chief purpose is to secure those observations that will be of the greatest value to the professional astronomer. During fourteen years of persistent endeavour on the part of nearly three hundred observers, the association has accumulated over two hundred thousand visual observations.

With active observers in all walks of life, from the surgeon who uses an eight-inch reflecting telescope of his own make, to the housewife who carries out her small glass each clear night to study the stars, the personnel of the society is truly representative and widely varied.

With numerous telescopes at their disposal, ranging in size from less than three inches to more than twenty inches in aperture, observers follow systematically the regular and irregular variations in the light of nearly five hundred stars. Not only are observations made regularly by members situated in nearly every section of the United States, but a chain of observers now encircles the globe, with contributors from Europe, South Africa, Australia, India, and Japan. So completely is this work now carried on that professional astronomers rely almost entirely on the results of these amateur observers for the fundamental data necessary to a better knowledge of the causes underlying the variations.

Many of the stars which are being so carefully observed by the "A.A.V.S.O." are the so-called long-period variables: their variations are usually gradual, and they occupy several months in passing from maximum to minimum magnitude. A star may be of naked-eye brilliance to-night, and four or five months hence we may require the aid of a moderately large telescope in order to see it.

A Recent Discovery.

A notable example of such a star is Mira Ceti, the "Wonderful," in the constellation of Cetus, the Whale. In December, 1925, it was near maximum brightness, and clearly visible to the unaided eye. This was the first variable star ever discovered, and for over three hundred years its light variations have been closely watched by succeeding generations of astronomers, professional as well as amateur. About every eleven months it reaches maximum brilliancy, being sometimes as bright as the Pole star, at other times not much brighter than the fourth magnitude. It is readily recognized when bright by its reddish colour, and the recent observations by amateurs indicate that its last rise from minimum to maximum occupied about two months, the rate of increase at one time exceeding a magnitude in ten days.

Not only are the several hundred long-period variables well looked after by the amateur observers, but their working lists contain some very peculiar "irregular" variables, made the more interesting by the fact that we never know exactly what they will do next. Numerous examples could be cited, but I shall pick out only a few typical cases to give an idea of the whims and vagaries which they present. Take the case of SS Cygni—a variable star discovered at Harvard in 1891 in the constellation Cygnus, the Swan. Here we have a fairly faint star, usually about the twelfth magnitude, which at intervals all the way from twenty to ninety days suddenly brightens up nearly a hundredfold, almost reaching the eighth magnitude. The time of the star's rise to maximum is unpredictable, and also the speed with which it increases in light intensity is variable. To-night it may be barely visible in a four-inch telescope, and to-morrow night it may be at full brightness, so brilliant, in fact, that it stands out as the brightest star in the field of view in the telescope. At other times the star may have started on its increase, and instead of accomplishing it in a night or two, it may consume a week or more in attaining its maximum. Is it any wonder that scores of amateurs vie with one another to be the first to catch SS Cygni on its rise to maximum? There are several other stars which possess this fitful type of variation, but SS Cygni has proved the most popular with observers.

An example of still another type of variable, that has greatly interested American amateurs is SU Tauri, a faint star which lies in the constellation of the Bull. This star, discovered to be variable at Harvard about twenty years ago, presents features quite distinct from those found in SS Cygni. In SU Tauri we have a star which for a long time remains at normal maximum brightness, about magnitude 9.5, and then without warning suddenly diminishes to nearly a hundredth part of its original intensity, becoming so faint, indeed, that only those observers with the more powerful telescopes can see it. About eighteen months ago the star passed through one of its spasmodic drops to minimum, after having remained bright for seven years. In fact it changed so little in those seven years that some of the observers wondered if they had not been observing the wrong star, because in the field of such faint stars a wrong identification is easily possible. At the end of last year the star was again on the wane, the Harvard Observatory having been first notified to this effect by an amateur in Ohio.

I could describe at greater length the vagaries of numerous irregular variables, but enough has been said to indicate some of the thrills to be expected when one has become an experienced variable star observer. The work is not difficult. It requires considerable perseverance and patience, and a readiness in identifying stellar configurations, whether in the sky or the telescope. The "A.A.V.S.O." supplies its members with charts, instructions, and report blanks, and anyone interested is invited to write to the Harvard Observatory, or to the secretary of the association, Mr. William Olcott, 62 Church Street, Norwich, Connecticut, U.S.A.

A closer relation between amateur and professional will doubtless tend towards a more widespread interest in astronomy, and both astronomer and amateur will benefit by the contact and co-operation.

Correspondence

(*continued from page 319*).

Mr. J. J. Macdonald of Edinburgh writes:—

"In his letter to you of 5th July, Mr. T. Leonard Jenkins considers the word 'tellar,' as applied to a tree, to indicate the tree which 'tells,' or counts, the number of the cut.

"It may interest Mr. Jenkins to know that in Scotland a bank cashier is called a 'teller,' and the bank counter is the 'telling table.' The verb 'to tell' is also used, but not so commonly. I notice that Pepys in his Diary writes of the 'teller's clerks of exchequer,' who seemingly had to do with paying out money."

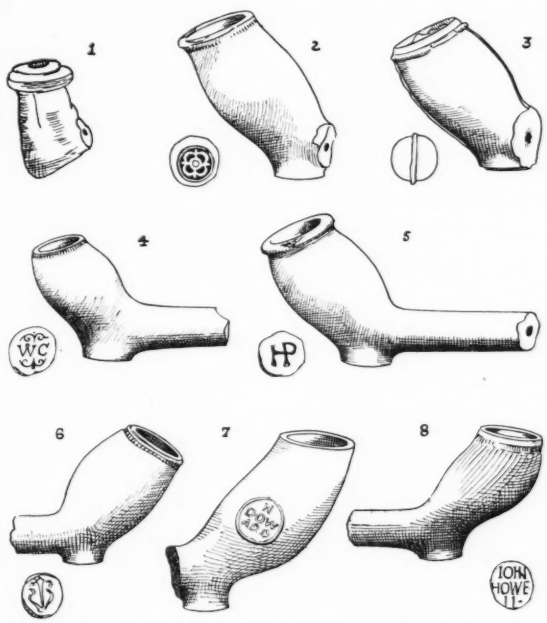
Old English Clay Pipes.

By F. W. Hermessen.

Illustrated with Sketches by the Author.

"The pipe, with solemn interposing puff,
Makes half a sentence at a time enough."—Cowper.

DURING the earlier part of this year, while foundations were being made for an extension of premises in Lewin's Mead, Bristol, on the site of the old Grey Friars Monastery, a number of interesting objects were unearthed. Among these finds old English clay pipes predominated, and before describing some of them it may be well to inquire why so many were found in this particular place. Detailed information on the point is lacking, but my own opinion—and I give it for what it is worth—is that in all probability an inn once stood there. After a pipe was done with it was thrown away; at any rate hundreds of broken ones have been discovered on the site, very few perfect specimens being found among them. What quantities of pipes were used in this way may be gathered from an interesting survival at a certain old-world inn in Cornwall where, at least until a few years ago I understand, a clay pipe was provided as a matter of course when a tankard of ale was ordered.



ENGLISH CLAY PIPES OF THE SEVENTEENTH CENTURY.
These have flat heels, bearing the maker's sign or initials, and the edges of the bowls are usually milled.

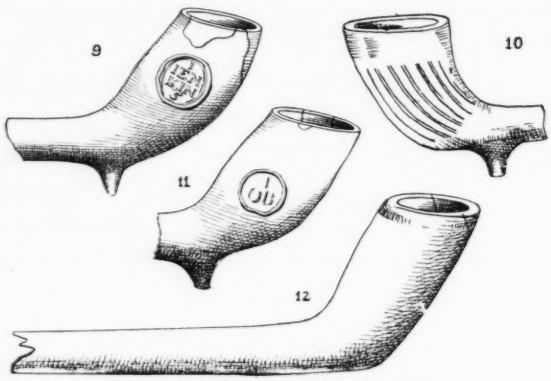
Undoubtedly the most interesting pipe among the Bristol finds is seen in Fig. 1. Owing to its particularly small bowl—its internal diameter is $\frac{3}{8}$-inch—this evidently belongs to the Elizabethan period, and is therefore one of the earliest examples of an English clay pipe. The bowl has a broadish rim—$\frac{5}{16}$-inch in width, which is a somewhat unusual feature; the maker's name was originally imprinted in a panel on the surface of the bowl, but unfortunately the letters have in the course of time become obliterated.

Most of the pipes bear on the heel of the bowl a Tudor rose, as the specimen shown in Fig. 2, but although I have made every effort to trace the name of the maker of this type I have not yet succeeded; those I have identified belong to the seventeenth and eighteenth centuries. Pipes of the first of these periods have flat heels and usually milled edges; almost all the specimens found were made about 1660, and many are marked with the initials or sign of their makers, either on the heel or the bowl. Some of these are shown in the first group of sketches, including pipes made by William Chearington (Fig. 4), Edward Lewis, Robert Hancock, Humphrey Partridge (Fig. 5), Philip Edwards, H. Doward (Fig. 7) and John Howell (Fig. 8). The last two of these bear the names in full, and they all have pleasing shapes. Of the pipes whose maker is unknown mention may be made of that shown in Fig. 3, this having two seams round the bowl. Fig. 6 is of a specimen also bearing a mark instead of initials.

A typical eighteenth-century pipe (Fig. 9) has the characteristic pointed spur in place of the flat heel of the earlier pipes, and is sometimes made of a thinner clay. Its maker was named Jenkin, and the number five appears below the wording, this being the only pipe found bearing a number as well as letters. Another specimen is seen in Fig. 11. The designer of the fluted pipe (Fig. 10) was evidently bolder than his rivals in introducing this element into the mould. Probably the pipe of latest date among those of the eighteenth-century period is shown in Fig. 12. It was found with a stem of over five inches long, and when originally turned out it may have measured three times this length. As the heel is neither flat nor spurred, the pipe belongs to the latter part of the

century or perhaps to the beginning of the nineteenth. That most of the pipes described have very small bowls may be attributed to the fact that during these periods tobacco was scarce and expensive.

The other day I came across a newspaper cutting of a somewhat later date—November, 1838—which adds another interesting fact to the history of the clay pipe. It is entitled "Smoking Intelligence," and reads as follows:—"Cigars seem to have had their day—their novelty has ceased—they have no charms for the elite, since almost every shop-boy and little urchin sports a real Havana in the streets.



SOME EIGHTEENTH-CENTURY SPECIMENS.
The pointed spur is a characteristic of this period. The pipe in Fig. 12 possibly belongs to the early nineteenth century.

"Common short clay pipes now claim precedence, and many gentlemen, dressed in the first style of fashion, may be seen nightly enjoying the fumes of tobacco from short dudheens, parading Regent Street, and the principal thoroughfares in that neighbourhood."

In conclusion I may mention that I am to-day smoking a clay pipe made in 1660 by one of the makers referred to—William Chearington—and a cooler pipe I have never smoked. This is not to be wondered at, since it had been buried in dampish soil for nearly three hundred years, which has made the clay very porous.

The Spleen and its Functions.

Professor Barcroft's Theory.

Of all the bulky organs of the body the spleen is the one remaining the function of which has not been fully elucidated. Although the organ can be removed without apparent effects, Professor Barcroft has lately suggested a new theory of its functions.

THE disproportionate importance of small organs in the human economy is being heavily stressed to-day. To organs smaller than a nut, such as the pituitary gland at the base of the brain, and even to a few scattered cells such as are found in the pancreas, are to-day assigned the most vital functions. It remains, therefore, all the more extraordinary that one of the largest organs in the body—the spleen—has never been proved essential to life or health.

Of course, many other organs are of no use, so far as can be seen. The appendix is chiefly of value to the surgeon who removes it. There are some surgeons—at least one surgeon—who attributes a similar value to the whole large intestine. But the appendix is a rudimentary structure; a little piece of architectural detail overlooked during the modernization of the premises. One can easily understand that it is of historical interest only. Similarly, the fact that one kidney can be removed without ill effect is not surprising: there is another one there to carry on the business.

But most of us have only one spleen. It is about fifteen cubic inches in volume, weighs half a pound, and is located on the left upper side of the abdomen. There it remains, peaceful and respectable, all our life long. We never feel it, and if, yielding to the blandishments of a surgeon, we have it out, we seldom miss it. It would appear, at first sight, to be useless.

Such a situation is an offence. We tend to believe to-day that the organization of our bodies must be at least as rationally planned as our own humanly-directed inventions. We may be wrong in that; many eminent physicists have said very uncomplimentary things about the eye as an optical machine. But it may be of interest to discuss the theories which have been advanced as to what the spleen does, and how it does it.

In the first place, support is given to the theory that the spleen must have a use in that it has a very large blood supply. It is obvious that the blood does not go there just to nourish the organ; and one of the earliest theories of the spleen's function was that substances were added to the blood in the spleen, a theory that foreshadowed the "internal secretion" theories of to-day.

The structure of the spleen, under the microscope, brings it into the class of lymph glands. There are thousands of lymph glands, at their largest little

bigger than a pea, all over the body; they enlarge during infections, and are factories of white blood corpuscles and destroyers of bacteria. The spleen only differs from them in that large volumes of blood circulate through it, round and about these white blood-cell factories.

There are thus two obvious functions of the spleen—firstly, as the largest single factory of white blood corpuscles, and, secondly, as a place of destruction of worn-out red cells. Apart from these, there are roughly a dozen other functions which have been with some degree of plausibility assigned to it. But the same difficulty meets us with regard to all of them: when the spleen is taken out the body carries on all these functions as well as ever.

Strange Diseases.

But if the working of the normal spleen be strange, its diseases are stranger still. It enlarges more than any other organ, and may fill the entire abdomen. The "pot-bellies" of little nigger children are very often due entirely to a huge spleen, caused by malaria. In several other diseases the spleen gets bigger still; and though in these diseases the large spleen may be the most obvious sign, its removal is usually of only the smallest temporary value.

The operation for removal of the spleen is, of course, rarely necessary in healthy men—for example, after gun-shot wounds. Such men seem in every way normal afterwards, though of course one cannot be certain that they have undergone every possible experience in which a spleen might have been a help. Similarly, animals whose spleen has been removed seem perfectly fit. They can, however, be submitted to any desired condition, and their reactions compared with the normal animal. Here, again, very little difference is noticed and, as a rule, that difference is found in such questions as the coagulation of the blood, which is the happy hunting-ground of experimenters suffering from barrenness of the imagination.

Recently, however, Professor J. Barcroft, whose experiments on the blood as a carrier of oxygen are classical, has advanced a theory which is of considerable interest. He believes that the spleen is really a reserve, a "hidden store" as he calls it, of blood, ready for emergencies, and to a certain degree remote from the changes and chances that overtake the blood as a whole.

If that be true, it explains a great deal. The large blood supply is sent to the spleen much in the way a business company puts money to a reserve fund; and we can do without the spleen, simply because the emergencies for which it is provided are uncommon.

The experimental evidence for these statements is as follows. Carbon monoxide, present in coal gas, owes its popularity as a method of suicide to its power of combining with red blood corpuscles. Their normal function is to combine, loosely, with oxygen; the combination with carbon monoxide is a relatively stable one. The suicide therefore dies of asphyxiation, since he cannot absorb any oxygen through his lungs when all available red cells are saturated with carbon monoxide.

Now, if animals are made to breathe carbon monoxide, the blood in the spleen contains only minute quantities of the gas, when the blood in the veins has large concentrations of it. The spleen is removed, in some way, from the poisonous gas, and with it its store of blood—perhaps a fifth of the whole blood.

Moreover, animals without a spleen, which has previously been removed by operation, succumb more readily to coal-gas poisoning than those with one.

Normally the spleen contracts and expands rhythmically. It is suggested that by this means its store of pure blood is sent into the circulation, to tide over a time of acute stress as, for example, coal-gas poisoning, when fresh blood may be sent into the circulation. Such times of stress may also occur when the heart is overburdened with blood, and then the spleen may remove some of the blood from the general circulation for the time being.

One would like, however, to know whether other organs—for example, the liver, which is far larger than the spleen and also has a similar function in breaking down old red cells, also maintain a store of blood remote from such influences as carbon monoxide poisoning. Only such blood as reaches the lungs comes directly into contact with the gas, and there is nothing to prove that the blood of a large vein contains more than a representative sample of red cells coming from many organs, and that a large number do not normally remain behind in the organs, to be later swept on into the general circulation.

However that may be, Professor Barcroft's research has provided as plausible an explanation as any of the use of the spleen.

A Discovery Confirmed.

WHILE on a special African flight in 1920, Dr. Chalmers Mitchell reported he had crossed an hitherto unknown field of extinct volcanoes north of Khartoum. That this area exists has just been confirmed by a letter in *The Times* of 18th August, which states that the Governor of Barber, Mr. Jackson, chanced upon it while exploring by motor-car.

The Month's Wireless Developments.

THE B.B.C. PRONUNCIATION COMMITTEE.

By Edward Liveing, M.A.

(Manchester Station Director, B.B.C.).

THERE is an amusing story of the conversation that took place between a gilded youth walking from clubland towards Piccadilly Circus and a chauffeur whose car was standing by the curb. The youth had noticed on the back of the car the letters E Y on the number-plate. Interested in number-plates, he asked the chauffeur the question "What's E Y?" The chauffeur promptly replied "About 'alf a ton, guv'nor."

The introduction of steam and electricity in the nineteenth century and, generally, the consequent facilitation for travel and telephonic communication, resulted in the modification of British dialects. This modification was undoubtedly carried a step further during the war, when educated and uneducated men from all parts of Great Britain mingled together in the ranks of the fighting forces. Only a modification, however, of dialects has taken place. They are still strong in their hold over the populations in the different quarters of the kingdom, and even amongst educated persons it is still easily possible to notice subtle variations in the pronunciation of words.

From its inauguration in this country it was obvious that broadcasting was destined to exercise a greater influence on the pronunciation of the language than any other social force. The B.B.C. has always recognized its responsibilities in this direction and the need for securing announcers, and lecturers as well, who could provide the public with the articulation and pronunciation of words as used by the majority of educated persons.

The problem of pronunciation presented to the B.B.C. is one that is most complicated and difficult of solution. An advisory committee to the B.B.C. on spoken English has now been formed and its first meeting took place on 5th July. The members of the committee are Mr. Robert Bridges, Poet Laureate, Chairman, Sir Johnstone Forbes-Robertson, Mr. Daniel Jones, Professor of Phonetics in the University of London, Mr. Logan Pearsall Smith, representing the Society for Pure English, and Mr. Lloyd James, Lecturer in Phonetics at the School of Oriental Studies, London.

It should be pointed out that neither the B.B.C. nor this committee have any intention of standardizing the English language. There is, however, a need for standardizing to some extent the pronunciation of announcers and other officials, particularly in the case of words which have not yet become exceedingly common in speech—long literary words, scientific terms, and so forth.

There is not space to enlarge here upon the findings of the first meeting of the committee. The really interesting point to note at the moment is a point that was emphasized by the secretary of the committee, Mr. Lloyd James, in a broadcast talk on the evening of Wednesday, 4th August, and that is that the committee will form a sort of living pronunciation dictionary for the B.B.C. The value of a living, rather than a book dictionary, is obvious from the statements that Mr. James made in this talk, for he pointed out how the general pronunciation of words changes even in the course of a few years. He took, for instance, the word "aerial," which ten years ago was pronounced by most people as *a-er-i-al* and is now pronounced *airial*. A significant fact is that the Oxford Dictionary still records the old pronunciation, now defunct.

In a future issue I hope to be able to record more in detail the work and findings of this extremely interesting new committee.

MARINE DIRECTION-FINDING.

By F. H. Masters.

Editor of "The Electrician."

IT is no exaggeration to say that the installation of wireless telegraph apparatus on board ship has meant the saving of thousands of lives. It has made it possible for a ship in distress to send out a general call signal which is, of course, invariably responded to by all ships and shore stations within reasonable distance. The provision of equipment to ensure this communication is compulsory on all ships above a certain tonnage, while, even if the ship sinks before help arrives, communication can still be maintained by the apparatus, which recent regulations ensure shall be carried on a proportion of the life-boats.

In certain weathers, however, the ship with its crew and passengers is exposed to greater risks in narrow waters than she is on the high seas, particularly during fog. To ensure safety under these conditions wireless again is of great assistance, as it enables a ship to check her position from time to time, and thus to steer a course which shall keep her free from shoals, rocks, and other dangers. This particular application of wireless is known as direction-finding. Like many other applications of scientific principles to commerce it underwent considerable developments during the great war, not the least interesting of which was the tracking out of raiding enemy airships. The problems that have to be tackled are not, however, so simple as may appear at first sight, and much work is still being done on the subject, especially by the Radio Research Board of the Department of Scientific and Industrial Research. Considering the importance of the subject to a maritime nation like our own it may be interesting, without going into too many details, to say something about the principles upon which direction-finding is based.

The ordinary wireless aerial, such as is used in broadcasting and commercial work, is non-directional. That is, it transmits signals in, or receives them from all directions. Receivers of this kind are also used in some systems of direction-finding, notably the Marconi short-wave directional beam stations at Inchkeith and South Foreland. The directive element in this case is obtained by employing a rotating aerial that sends out a signal the exact character of which depends on the position of the aerial at the moment. If a ship picks up a certain signal more strongly than any other, she knows that within certain limits she is on a definite compass bearing from that station, the exact direction being, of course, determined by a code. For instance, she can tell whether she is due east, south-east, or north-east of the South Foreland station.

Directional receivers are also used for direction-finding, and in this case a certain element of skill is required by the ship's wireless operator. These receivers consist of a closed loop antenna, which can be rotated about a vertical axis. The operator turns this antenna until the signal he is receiving from the transmitting station vanishes. The position of his antenna

loop then gives the direction of the straight line joining the ship and station. In a modification due to Robinson, two loop antennae fixed perpendicularly to each other and electrically connected in series are used. If the loops are in such a position that no change occurs in the signal strength received when a switch is operated, the larger loop of the two is perpendicular to the direction of the transmitting station. This arrangement gives a sharp minimum, and is easier to use than the zero method.

In both cases it is necessary to observe two transmitting stations so as to fix the ship's position on the map. The accuracy of the result depends to a large extent on the observations, and these must therefore be carried out as carefully as possible. Care must also be taken in the design of the apparatus to prevent stray forces from giving erroneous signals. What, however, makes the problem really difficult is the difference that occurs in the propagation between the two stations concerned. These differences, which are exhaustively dealt with in a report of the Radio Research Board, are much more noticeable by night than by day.

The work described in the report consisted of a large number of organized directional observations which were made at two receiving stations, one at Slough and one at Orford on the East Coast. The sending stations checked lay along the coast between Wilhelmshaven in Germany and Rochefort in France, and were nearly all of the fixed-spark type. Some special tests were also made on signals sent out from an experimental station at Teddington and from the Great Eastern Railway vessels, while voyaging between Harwich and Holland.

As the result of these experiments it appears that the extreme daytime variation is not more than 7 deg., but this may increase to as much as 100 deg. at night, 30 deg. being quite common. In the daytime again, the signals are not usually missed owing to the absence of a defined minimum, but this source of error is frequent at night, especially when the signals are sent overland.

The rough practical conclusion to be drawn from these investigations is that by day bearings can be obtained with a degree of certainty and accuracy quite high enough to be of service to navigation, while the same holds good at night for overwater distances up to 80 miles. For land and for longer sea distances no useful results can be expected. Further work will, therefore, be required to determine how this important source of error may be overcome.

Book Reviews.

(1) *Ouroborus, or the Mechanical Extension of Mankind.* By G. GARRETT. (Kegan Paul. 2*s.* 6*d.*).

(2) *Artifex, or the Future of Craftsmanship.* By JOHN GLOAG. (Kegan Paul. 2*s.* 6*d.*).

(3) *If I were a Labour Leader.* By ERNEST J. P. BENN. (Benn. 3*s.* 6*d.*).

A first glance at the titles above may require a reason for reviewing these three books together or, at any rate, for including the third in one notice. Machinery and craftsmanship are obviously related, and the future of the one involves the future of the other. So closely associated with these factors, however, is the human machine, that their discussion must inevitably take into account the attitude of labour. Labour would do well to adopt a decided point of view on the problems of industry, following the lesson of the recent general strike; and the future of trade to an enormous extent will depend on what this policy is to be.

(1) The gist of Mr. Garrett's book is that millions of men have been created by machinery, without which they could not exist. This point is of fundamental importance in discussions affecting industry, and it is one which is all too frequently overlooked. The author puts the matter in rather an unusual light. He points out that in regarding himself creator of the machine man forgets that the machine is no less creator of him; that in bending vast forces to his purpose he is bringing further forces into being which in their turn will require human beings to manage them. Every scheme of reverting to more primitive methods of labour therefore must, if successful, bring with it the wiping out of a corresponding proportion of the population. On the other hand, Mr. Garrett suggests that with an ever-increasing capacity for mechanical production the world will before long arrive at the point when all its markets are saturated; the agricultural population everywhere reduced to a minimum by the premium attaching to industrial employment, food supplies will diminish, and general starvation will put an end to civilization. Evidence of this tendency, the author argues, is the growing practice of selling by instalment, manufacturers being forced to resort to every device for disposing of their goods in the universal struggle for markets. The paper jacket of this book asks whether there is not a flaw in this argument; another of the books under notice furnishes an answer.

(2) With the rise of the machine, there "presently began what has been called without reason or thought—the war between craftsmanship and machinery." In other words, Mr. Gloag gratefully accepts the additional power the machine gives to the craftsman without, however, approving of every use to which the new instrument has been put. Thus the process of smashing up civilization will become ever shorter and more possible as the machine develops, but this is just another argument for the intelligent use of its power. The author foresees the craftsman satisfying with the mechanical tool not only the needs of everybody, but his own aesthetic sense, constructing articles more beautiful and more perfectly finished than was ever possible without its aid. For this reason the product of the smock-clad habitue of Chelsea, which gains such adjectives as "quaint" or "charming," is retrograde, true craftsmanship being a virile, practical, and progressive force.

(3) How machinery has benefited mankind is nowhere better illustrated than in America, where the working man to a greater extent, perhaps, than in any other country, has had the sense to regard it as his most valuable aid. In Britain, on the other hand, the unsound if perfectly understandable notion has grown up that the machine robs a man of his work, with all the resultant symptoms which culminate in deliberate "going slow." Sir Ernest Benn is the last person to blame labour for this attitude, realizing that it is inspired by loyalty to the solidarity prevailing in its ranks. That there is any limit to the material requirements of the world, however, he refuses to admit, taking the case of the household bath as an illustration. If all the people capable of making baths were to set themselves to the task of supplying this simple need, in ten years they would still be no nearer to effectually satisfying the demand for it. This being the case, the more machinery the better; and since wages come out of production, if the working man will take full advantage of this aid he can reap the full reward in remuneration. Sir Ernest does not suggest any alteration in the existing arrangements of labour; he pleads instead for a change

of outlook. As for the unparalleled prosperity that might result from such a change, it is humorously suggested that in contrast to imposing a condition as recently that no printers' trade union "chapels" shall be held in working hours, instead the employers will be paying double time for such meetings, so beneficial will be this new co-operation. The last chapter of this book bears the hopeful title "A New Start."

Cannot we appreciate and put into effect, before it is too late, the tremendous powers of man and machine which are only waiting to be discovered?

J. A. B.

A Dictionary of Modern English Usage. By H. W. FOWLER. (Oxford University Press. 7*s.* 6*d.*).

Mr. Fowler's book is the most delightful dictionary imaginable. On every page there is some persuasive and witty little essay illustrated by apt quotations and dealing either with some question of syntax or of style. Some of the points he raises are interesting and worth discussion. For example, the expression "try and" for "try to" he officially blesses. Here he is on very debatable ground. Dr. Vizetelly some years ago fulminated furiously against its use, declaring it contradictory, slipshod, and against all good usage. More recently, Mr. Wilfred Whitton, better known as "John O'London," and one of the best essayists of the day, said that if he could have his way he would hound it out of the language, while Sir Arthur Quiller Couch includes its use among the seven deadly literary sins. It is a little difficult to see why it should be disallowed. After all, to "try and" do a thing is not the same as "to try to" do it. The trouble is that often the one expression is used where the other is meant.

Two of the most pungent and amusing sections of the book are devoted to what Mr. Fowler calls "Genteelisms" and "Wardour Street English." By the first he understands "the substituting for the ordinary natural word that first suggests itself to the mind, of a synonym that is thought to be less soiled by the lips of the common herd, less familiar, less plebeian, less vulgar, less apt to come unhandsomely between the wind and our nobility"; the use of *ale* for beer, *anent* for about, *assist* for help, *carafe* for water-bottle, *dentifrice* for toothpaste, *edifice* (a most hateful word) for building, and so on. Among the Wardour Street collection are "albeit," "anent," "ere," and such phrases as "you shall find" and "if it be." "Galore," Mr. Fowler comments, has no proper place in the Englishman's vocabulary, and is a favourite with those who write letters to the press. Under the heading of "Novelese" he damns impartially those mainstays of the newspaper serial such as "living death," "supreme" or "psychological moment," "demonic energy," "diabolical malignity," "magnetic personality," "sinister machinations," "utter abandon" and "serpentine charm." One of the most irritating habits affected by some of our journalists, who ought to know better but will weakly indulge themselves—the inversion of the verb, comes in for a scathing examination. Its abuse, he says, ranks with elegant variation as "one of the most repellent vices of modern writing . . . resorted to in the false belief that artificiality is more beautiful than nature."

With regard to the end preposition about which the pedants have so furiously raged together, Mr. Fowler takes up a very sensible position, and points out that the remarkable freedom enjoyed by English in putting its prepositions late and omitting its relatives is an important element in the flexibility of the language. Contending that its use should be allowed to remain at the writer's discretion, he gives a formidable list of references to the masters of prose of all periods. It may also be objected that the avoidance of the preposition at the end of the sentence necessitates further relatives and so leads on to the sins of "be-whiching" and "that-ching" which so frequently characterize bad writing. Upon the equally vexed question of to split or not to split infinitives the author remarks "those upon whom the fear of infinitive splitting sits heavy should remember that to give conclusive evidence by distortion of misconceiving the nature of the split infinitive is far more damaging to literary pretensions than an actual lapse could be." It is often awkward and clumsy to distort in order to avoid a split infinitive and conversely more natural and smoother to split it. Again, too, the adverbs which cause the division are rarely necessary.

Towards the end of his book Mr. Fowler discusses superfluous words of which he gives a fairly long list. That monstrosities like "minify," "smoothen," "succedaneum," and "epopee," are superfluous few would deny, but there is surely a place for "vice-regent," "vice-royal" and "rotatory."

There are several things which Mr. Fowler might have dealt with but for some reason did not. Commercial English, baby language, clericalisms, "refanement," occur to the mind. Perhaps he will include some consideration of these and other matters in a later edition of his book.

J. L. T. J.

Bulletin of the Imperial Institute. Vol. XXIV. No. 1. 1926. (John Murray. 3*s.* 6*d.*).

Presumably owing to the general strike, the first quarterly issue of this year's *Bulletin of the Imperial Institute* was delayed until June, and with this number several important changes in its form are contemplated.

The present issue suggests a new departure in regard to its two sections dealing with (*a*) plant and animal products, and (*b*) mineral resources, the publishers asking an expression of opinion from their subscribers as to whether these sections should in future be bound together or issued separately. The publication of the *Bulletin* quarterly, as hitherto during the last twenty-three years, or whether it should be issued half-yearly, is another matter now under consideration, but it is proposed to delay a final decision until later in the year.

Religion and Folklore of Northern India. By WILLIAM CROOKE, C.I.E. Prepared for the Press by R. E. ENTHOVEN, C.I.E. (Oxford University Press. 21*s.*).

Although the editor who has been responsible for seeing the late Dr. Crooke's manuscript through the press is correct in describing this volume as a new edition, it contains so much new material that it might almost equally well have been described as an entirely new book. The guiding principle remains in the main unchanged; the material has, for the most part, been gathered since the previous issue of the book.

Dr. Crooke was first led to the study of his subject by his experience as a magistrate among the village populations of the United Provinces of Agra and Oudh. He noted that the vital belief of the people was something more deeply rooted, more potent than the official religion, and that this belief was largely based upon fear. With this as his key he unlocked the door to the peasant's mind, and gathered together a mass of information vital to the understanding of the mentality of the bulk of the population of Northern India, the Deccan and the Bombay Presidency. Beliefs fundamentally animistic in character can here be followed in their gradual development into the local cult of the hero and godling, whether the godling of Nature or of the village, until they attain wider significance. Thus they throw

light on the origin of the lesser deities of the Hindu Pantheon, deities who have been promoted from the animistic stage to orthodox rank. Other beliefs discussed here, such as fertility and agricultural rites, omens, serpent worship, and witchcraft, may be of secondary importance, but the chapters dealing with them are a mine of curious information of deep significance in the history of the development of the human mind. It is hardly necessary to say that this mass of detail is handled with that lightness of touch of which the lamented author was a master.

E. N. F.

A Short Course in Elementary Meteorology. W. H. PICK, B.Sc. (H.M. Stationery Office. *1s. 6d.*).

The first edition of this book was published in 1921, and the present edition has been slightly enlarged by the addition of further paragraphs to bring the subject matter up to date. The additional topics treated include the polar front theory of the Norwegian School of Meteorologists, Dr. Simpson's theory of the mechanism of thunderstorms, and recent work on the constitution and composition of the upper atmosphere. There are also two additional full-page maps giving the distribution of isobars over the globe for January and for July.

The book affords an admirable survey of its subject within the limits permissible to an elementary treatise. It is non-mathematical in character and does not presuppose any extensive technical knowledge. Meteorological phenomena are clearly and adequately explained in elementary terms, and an excellent and up-to-date account is given of modern methods of weather forecasting. The descriptions of the various types of pressure distribution and the weather associated with them will be of great value to those who desire a closer acquaintance with the meteorological terms found in the broadcasted weather forecasts.

This little book can be thoroughly recommended to those who, having only a very elementary knowledge of mathematics, desire to obtain an understanding of the phenomena of the weather and of the instruments used in meteorological observations.

C. B.

The Borderland of Music and Psychology. By FRANK HOWES, M.A., Oxon. (Kegan Paul, Trench, Trubner & Co. Ltd. *6s.*).

Mr. Howes is prepared to disregard the incompatibilities of the many schools of psychology and "do an addition sum wherever one method will supplement the other," and justifies "such an apparently immoral proceeding" in a book of remarkable insight and breadth of view. He writes of "Psychology *and* Music," so we find not a psychologist's study of music, but a series of essays upon the relationship between music and ordinary normal life, illuminated by whatever light psychology and philosophy can afford. Professor Freud's theory that all art is a fulfilment, in fantasy, of the desires for pleasure which are frustrated by the conditions of everyday life, is very justly criticised as falling "into the evolutionary fallacy of reducing what is to what was." Mr. Howes points out that this Freudian principle of compensation adequately explains the appeal of a great deal of art, but most adequately the worst kind of art, the penny novelette, the drawing-room ballad, and other such luscious and satisfying fare. He admits that the principle of compensation explains the curious contrast that we often find between a composer's temperament and his work, and gives the saintly character of Cesar Franck and the diabolic quality of his music as one example among many. But it is perhaps allowable to question here whether the theory of compensation may not be carried a little further, and to suggest that just as bad art satisfies the pleasure principle so the better kind of art may satisfy Freud's reality principle, offering us in resolved discords and subtly complex harmonies a compensation for our own imperfect adaptation to reality.

Mr. Howes finds that the "gregarious instinct" of McDougal throws a great deal of light upon the vexing necessity of applause and also provides a useful guide to the composition of successful concert programmes. The book is written with a minimum of technicality in either field, and the author's alert sense of humour and vigorous, flexible prose will hold the attention of anyone who has the least interest in music.

F. A. H.

A Short History of Chemistry. By ROSE STERN, B.Sc. (J. Dent. *2s. 6d.*).

The author modestly supposes that this is a book primarily suitable for the use of boys and girls beginning the study of chemistry, in which the story of its development is told, but in our opinion it will be even more appreciated by those already familiar with the science, who will be the better able to judge the excellence of Miss Stern's work.

In the first place we are told many interesting facts about early chemists. With the now established prestige of bio-chemistry, for instance, how many people know that so early as 1400 Basil Valentine wrote of the unchemical medical man that "he thumps medicine in his mortar, and health out of the patient." We are further told that among the "curious ideas" of John Baptist Van Helmont (1577-1644) he conceived the soul as having its seat in the stomach where it directed the first digestion; but perhaps his views were not so curious after all!

Then, the author has rendered a very valuable service in relating chemistry to the facts with which the student is already familiar. Too frequently history is learnt in several water-tight compartments, but in the present book a typical anecdote reminds us that Robert Boyle lived in retirement throughout the unhappy years of the Civil War, in which one of his brothers had been killed fighting in Ireland.

The chapter on Joseph Priestley in itself makes the book worth its very low price.

Plato's American Republic. By DOUGLAS WOODRUFF. (Kegan Paul. *2s. 6d.*).

We could not read more than a few pages of this story of what happened to Socrates when he went on a lecture tour in the United States. Where or when the author acquired his experience we are not told, but unfortunately his estimate of the American is most superficial. This of itself is not unusual—indeed, it may be said to be common to nearly everyone who pays a visit across the Atlantic, and is consequently pardonable; but when it gives rise to false generalizations of a kind disparaging and discourteous to a great and hospitable people, such ignorance cannot be too strongly condemned.

Cheap jibes at mass production, American politics, and—of course—prohibition occur on nearly every page of this book, which will only amuse—but not in the way intended—those Americans who know more about ourselves than the author appears to know about them. On the cover, by the by, the reader is informed who Socrates was. It can only be supposed this precaution is thought necessary in the interests of those same Americans—*the ignorant creatures*! we seem to hear the author explain.

J. A. B.

Race and History : An Ethnological Introduction to History. By EUGÈNE PITTARD. "History of Civilization" Series. (Kegan Paul, Trench, Trubner & Co. 21*s.*).

"Race and History" may most profitably be regarded as being in its aim a treatise of applied anthropology. As such it will serve as an antidote to loose terminology and popular misconception. Since the war many catch phrases with a pseudo-claim to ethnological validity have become a trap to the unwary and a snare in international politics. Intelligent interest in such matters cannot be too widespread, and for such an enlightened understanding Professor Pittard's cautious and restrained work forms an admirable basis, however much we may differ from him in matter of detail. Accepting as his definition of race—accepting it that is as a definition for working purposes rather than as one pedantically guarded from criticism—Boule's "continuity of a physical type expressing affinities of blood," an essentially natural grouping "as opposed to the artificial groupings of history," he takes the principal racial groups of the world under their continental areas of distribution and reviews their anthropological history. His conclusion is, as might be expected, that there is no pure race to-day, and that even in the early historical periods the population of almost any nation was already mixed. His view is, therefore, on the whole contrary to the popular idea that "race has made history." On the data available in the present state of our knowledge this conclusion may be accepted; but the study of race and psychology has still to advance before it can be regarded as final.

Primitive Trade : Its Psychology and Economics. By ELIZABETH ELLIS HOYT, A.M., Ph.D. (Kegan Paul, Trench, Trubner & Co. 7*s.* 6*d.*).

Miss Hoyt's object in her "Primitive Trade" has been to provide a substitute for the abstractions of the older economists by the psychological analysis of the motives and methods recorded by the observations of the anthropologist among backward peoples. When once the fresh orientation derivative from such a method of attacking the problem has been attained, it becomes obvious that the psychological conceptions of the economist, which are still to a large extent based upon the theories of a previous generation, fail to take into account a number of factors which are operative in determining the behaviour of man as a member of a social group. Miss Hoyt shows that in trade three distinct processes are at work: a man must want goods; he must be able to conceive of them in terms of the valuation of other goods; and he must be willing to negotiate. With the last certain conditions must be associated: it involves not only "the physical extensions of trade relations, but also the growth of mutual confidence within a group." To the economist it may appear—indeed it is usually assumed—that the desire to obtain an advantage by exchange in some form or other may be postulated; but the examination to which Miss Hoyt has submitted the facts of primitive psychological and social conditions reveal that this is by no means the case. A variety of circumstances militate against the ideas, as indicated above, upon which trade is based; and even when exchange is an accepted institution the lines upon which it proceeds and the determining factors force upon "value" a wider meaning than that of the orthodox economist. Witness the ceremonial exchange of the Trobrianders described by Malinowski. Miss Hoyt has written an original and stimulating thesis in which the argument is developed with great lucidity. It will appeal to all who are interested in the psychology of social and economic phenomena.

E. N. F.

School Scholarships.

IT is announced that on the results of the recent examination at St. Paul's Girls' School, Brook Green, Hammersmith, Foundation Scholarships were awarded as follows :—

Senior : A. Abbott, N. Binyon, F. Clark, C. Forbes, J. Gray, M. Isaac, M. Layton, A. Lovel, B. Reeve, V. Trump, C. Turner, J. Whatley (*St. Paul's Girls' School*).

Junior : S. Galperin, *Willesden County School*; M. Lipman, *South Hampstead High School*; M. Lloyd, *County Secondary School, Fulham*; M. Pierrepont, *Retford County High School*; D. Rdıman, *Norland Place School*; M. Todd, *Kelvin House, Ruislip*; M. Beck, M. Gladwell, E. Grigg, D. Hubback, R. King, I. Tonkin, *St. Paul's Girls' School*.

Books Received.

The Annals of Archaeology and Anthropology. Vol. XIII. Nos. 1-2. June, 1926. (University Press of Liverpool. 0*s.* quarterly).

Science as Revelation. By JOHN M. WATSON. (Macmillan & Co. Ltd. 10*s.*).

Animals looking into the Future. By WILLIAM ALLISON KEPNER. (Macmillan & Co. Ltd. 7*s.* 6*d.*).

Early Medical and Biological Science. By R. T. GUNTHER, M.A., LL.D., F.L.S. (Oxford University Press. 7*s.* 6*d.*).

Monthly Circular of Recent Selected Publications. No. 88. May and June, 1926. (H.M. Stationery Office).

Fourfold Geometry. By DAVID BEVERIDGE MAIR. (Methuen & Co. Ltd. 8*s.* 6*d.*).

"Science for All" Series : Biology. By O. H. LATTER, M.A. John Murray. 3*s.* 6*d.*).

The Upper Palaeolithic Age in Britain. By D. A. E. GARROD, B.Sc. (Oxon). Oxford University Press. 10*s.* 6*d.*).

A Bipolar Theory of Living Processes. By G. W. CRILE. (Macmillan & Co. Ltd. 21*s.*).

The Threshold of Anglo-Saxon. By A. J. WYATT. (Cambridge University Press. 5*s.*).

Annuaire International des Périodiques d'Intéret Médical. 1926. (Louvain, Dr. Gobert).

Electrical Toys and Tricks. By A. F. COLLINS. (Cassell & Co., Ltd. 2*s.*).

Annual Report of the Geological Survey Department, Uganda Protectorate. 1925. (Uganda Government).

The Place-names of Bedfordshire and Huntingdonshire. By A. MAWER and F. M. STENTON. (Cambridge University Press. 18*s.*).

An Introduction to Experimental Embryology. By G. R. DE BEER. (Oxford University Press. 7*s.* 6*d.*).

Modern Marriage. By PAUL POPENOE. (Macmillan & Co. Ltd. 11*s.*).

Quarterly Journal of the Science Association. Maharajah's College, Vizianaram. (Methodist Publishing House, Madras).

Elements of Astronomy. By E. A. FATH. (McGraw Hill Publishing Co. Ltd. 15*s.*)

Proceedings of the Society for Psychical Research. Part 99. Vol. XXXVI. July, 1926. (Robt. Maclehose & Co. Ltd. 7*s.* 6*d.*).

Annual Report, National Institute for the Blind. 1925-1926.